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THE BRUSSELS EXHIBITION OF 1888.

THIS projected demonstration rejoices in a novel name. It is to be called the "Great International Competition of Sciences and Industry." The *Moniteur Official* rebukes the City Council for their parsimony in "carefully discussing the meagre subsidy of 250,000 francs." As a means of procuring the necessary funds the Government has sanctioned a lottery comprising several series of one million tickets each, a measure which, in this country, would be received with indignant protests, but which will encounter no resistance from the accommodating morality of the Belgians.

A very curious innovation has been proposed at one of the meetings of the "Committee No. 2." It is well known that at not a few exhibitions, international or otherwise, charges of favouritism and undue influence have been freely brought forward as soon as the awards of medals, &c., became known. To meet this difficulty M. Em. de Munck suggests that the various exhibits should not bear—visibly, at least—the name and address of the producer, but should be marked in cypher, each being accompanied by a sealed paper marked outside with the same cypher and containing within the full name and address of the exhibitor. These papers would, of course, not be opened until the juries had made their awards. This scheme might, perhaps, exclude favouritism, but it would be open to certain objections which have no existence under the present system of open naming. Thus the names of the unsuccessful competitors would never become known at all, and public opinion would no longer act as a check upon the juries. At present the technical press can form and give its own opinion upon exhibits, but what would be the use of praising, say, a novel dynamo, merely marked in cypher? We presume exhibitors will be in some manner bound not to publish their names and addresses before the close of the display. All circumstances being duly considered, we think that the advantages likely to follow from this scheme by no means warrant its adoption.

The tower, 300 metres in height, proposed by MM. Hennique and Néve as an annexe to the exhibition buildings, is still a subject of discussion in the Belgian and French papers.

Time Ball for Bradford.—The question of supplying a time ball for Bradford, which has been successively considered and shelved by the Chamber of Commerce and the Town Council, has now been taken up by the Coffee Tavern Company. This company, believing, no doubt, that temperance and punctuality are kindred virtues, has itself determined to rent a time current for the benefit of the town since no public body will do so, and a conspicuous red ball has been erected in front of its principal café.

HISTORICAL NOTES ON THE RING DYNAMO WITH INTERIOR MAGNETS.

IT not unfrequently happens that while some invention or discovery is being elaborated by the original discoverers, if a short note has been published in a technical journal of the principle involved, others rush at once into print with a description of a similar design; so that when the final work of the originators is fully developed and published, it would appear as though they were the plagiarists; when in point of fact, the contrary is the truth.

A case in point is the ring dynamo with interior magnets. A description of a dynamo of this type as manufactured by Messrs. Ganz & Co., of Buda-Pesth, has lately appeared in *Industries*, and any person reading the article would naturally be led to the belief that this firm was the originator of this particular type of dynamo.

Shortly described, the ring dynamo consists of a fixed central electro-magnet with four limbs at right angles to each other; through the centre of this electro-magnet passes the axle of the external Pacinotti ring, which revolves outside the fixed central magnet. The outside ring is of considerable diameter, and as it entirely surrounds the magnetic field, the lines of force must necessarily pass through it.

The first continuous current dynamo of this type with a Pacinotti ring, and with magnets inside the ring only, in the shape of a double T, formed one of the exhibits of Messrs. Siemens & Halske at the Paris Exhibition in 1881.

Since that time they have been occupied in developing and perfecting this form of dynamo, and on the 22nd October, 1886, an application was made by them to the German Patent Office. The specification describes the practically completed form of the ring dynamo with an interior multipolar electro-magnet. The communication with a detailed description and drawings was made public to every one in the usual way on the 14th January of this year in the Journal of the Patent Office. Moreover, in the same month of January, the detailed drawings of four large dynamos of this type were submitted by Messrs. Siemens and Halske with their tender for the electric lighting of the Frankfort Central Railway Station; and on the basis of this tender, the contract for the work was awarded to them.

At the meeting of the Berlin Electro-technical Society on the 29th March last, a paper was read by Mr. von Hefner-Alteneck on the "Ring Dynamo with Interior Magnets;" which paper was subsequently printed in the April number of the Journal of the Society.

No other publication had been made by Messrs. Siemens and Halske up to that time.

In the number of the *Zeitschrift für Elektrotechnik* (Vienna) of the 1st April, and in that of the *Centralblatt für Elektrotechnik* of the same date, the firm of Messrs. Ganz & Co., of Buda-Pesth, come forward with a dynamo which, if different in details, is yet in design similar to the Ring dynamo, and they state that in 1884 the question occurred to them to construct a dynamo capable of giving the greatest possible output, whilst having the least possible weight.

The *Centralblatt* accompanied this article by a footnote, to which it is desirable to give the widest possible circulation, while reproducing exactly the punctuation.

"Editorial Note.—The firm of Siemens & Halske is at present engaged in bringing out the same construction!!"

Messrs. Ganz & Co. maintain in the above-mentioned article that their dynamo is the offspring of the alternate current machine of the Zipernowski type which they have constructed. It might equally well be said that the much older Gramme alternate current machine, which has a Pacinotti ring outside, and electro magnets inside, is a much nearer parent to their new dynamo. Moreover, the Zipernowski machine constructed in 1882 or 1883, had a striking family resemblance to the

well-known Siemens alternate current machine as it was modified in the German patent of the 3rd April, 1878, and as it was constructed by Messrs. Siemens & Halske prior to Messrs. Ganz & Co., and shown at the Vienna Exhibition in 1883.

THE SHORT-NESMITH ELECTRIC RAILWAY.

IN the month of April, 1885, a company was organised in Denver, Colorado, under the name of the Denver Electric and Cable Railway Company.

This company was formed for the purpose of building and operating an electrical railway in the streets of Denver. It at once adopted a plan proposed by Sidney H. Short, then professor of physics in the University of Colorado, Denver.

Mr. Short called the attention of the gentlemen comprising this company to his series system of electrical railway, and a small piece of track, between three and four hundred feet, was laid in a circle in the university grounds. A small car, named Joseph Henry, was built, and carried many hundreds of people over the track.

The success of this little road encouraged the company to make more extended experiments in this direction. This first road, the New York *Electrician and Electrical Engineer* states, was built on the following plan. Two bare conductors were laid side by side along the track in a small conduit placed between the rails. The conductors were small and supported on insulators attached to the cross ties. The conductors were cut into sections in order to test the working of this system of conductors. Switches operated by the current connected the two conductors in multiple arc, making them practically one conductor having the conductivity and sectional area of the two. These electrical switches at the same time connected the ends of the sections of this double conductor making one continuous conductor along the entire length of the track. The ends of this working conductor were connected by means of wires with the dynamo. When a car was placed on the track and had its brushes or contact springs one on each of the parallel conductors of any section, the electrical switches at each end of that section would at once disconnect one of these conductors at one end and the other at the other end, leaving the only path for the current along one conductor through the motor to the other conductor and the line again. These sections could be made of any convenient length from that of an ordinary car to a block or a mile. A car could be on every section and the same current pass through all of them.

FIG. 1.

FIG. 2.

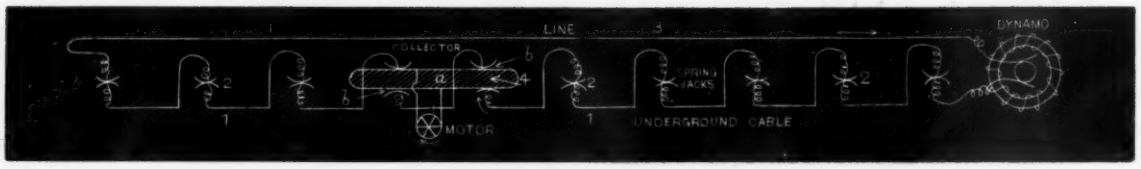


FIG. 3.

1. Sectional Conductor. 2. Contact Springs (Spring Jacks). 3. Return Wire. 4. Current Collector. *a*. Insulating Bar. *b*. Circuit Breaker.

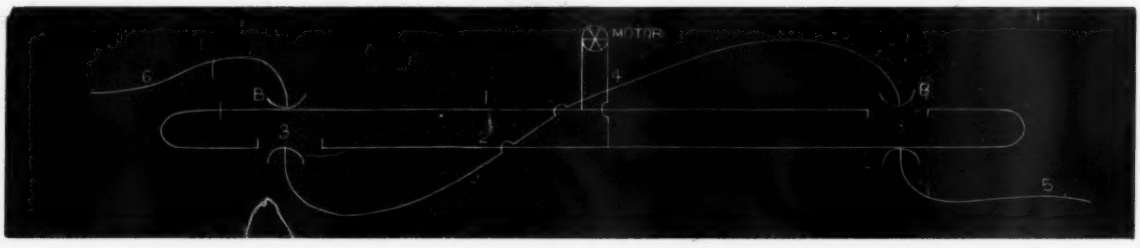


FIG. 4.

Mr. Short maintained that the only way to make a successful electrical railway was to use a constant current of a small quantity; run the cars in series like arc lamps or telegraph instruments, and vary the electromotive force with the power required to operate the line of road. This principle has not been in the least departed from since the enterprise was begun, but many modifications in the details of construction have been made from time to time.

The two conductors used in this arrangement were intended to carry the current in the same direction at the same time along the track and, as stated before,

they became electrically one conductor. At the junction of two sections there were four contacts to be operated by an electrical circuit closer which was necessarily a complex and delicate piece of mechanism to keep in good working order, especially when placed on the street where it was liable to injury. Mr. Short at once began to devise some means of combining the two wires into one in order to do away with one pair of contacts at the junction of the sections and also to lessen by half the chance for leakage from the insulating supports. He found only one thing to do—shorten the sections of the conductor to the length of one car or train of cars. This increased the number of circuit closers greatly, but at the same time increased the flexibility of the road, as cars could be run as close together as they could be placed on the track.

A contact brush must be placed under each end of the car or train of cars to make electrical connection with the conductor, so that there will always be a circuit closer between these brushes, as shown in fig. 1. The circuit closer between these two brushes must, however, be kept open as long as it remains between these brushes and must close the line as soon as the brushes pass beyond it. Electrical means for accomplishing this were devised, but it was open to the same objection as the one referred to above, and with the large increase in the number this objection became still greater. A mechanical circuit breaker must be provided. Mr. Short presented this problem to Mr. John W. Nesmith, a practical mechanic of long experience and of much ingenuity, and asked him to devise some mechanical plan for keeping the spring or circuit closer, shown in fig. 1, open so long as the car was over it. Mr. Nesmith proposed that a long slender bar of insulating material be stretched between the two current collectors or brushes, this bar to slide between the contact at the ends of the sections of the conductor, and keep them apart so long as the car is passing, as shown in fig. 2. In July, 1885, this second plan was tried on about 300 feet of track with the same car used in the first experiment. A brush at each end of the car made contact with two sections of the conductor; a leather strap stretched between the two brushes kept the springs apart as the car passed over the circuit closer. This experiment was a perfect success, and the desired end was obtained.

The Denver Electric and Cable Railway Company at once ordered the material to lay one-half mile of track upon this plan, and also two motors and one dynamo of the Short type. A small engine made by the Colorado Iron Works, of which Mr. Nesmith is president, was put in place near one end of the line. This engine was of the ordinary slide valve form, with a cylinder 9 inches by 12 inches. Two elegant coaches were built by Woeber Brothers in Denver. The conductor used in this trial was a slotted copper tube about one inch inside diameter. Each tube was about 16 feet long, and embedded in asphaltum and tar, the whole encased in an iron shell, a slot cut through, and was then spiked to the ties, with the slot at the top. Between the ends of these sectional conductors were mechanical contact closers. The car was provided with a contact brush at each end which fitted into the tubular conductor like a gun-wiper brush. Between these brushes was stretched a long flexible rubber cylinder which almost filled the tube. As the car moved along, the forward brush was pushed through the tube and contacts at the ends, the rubber rod followed and kept the contacts apart until the rear brush had passed, and the current was forced to pass from one brush through the motor and back to the other brush. In October, 1885, this half mile was completed, and for the first time a car driven by electricity made its appearance on Fifteenth Street in Denver.

The experience of a few days showed this plan to be impracticable on account of the difficulty of keeping this conductor insulated, and the further difficulty that a very little sand and dust in the tube stopped the brushes. The most serious trouble to overcome was the leakage due to imperfect insulation. This has been and is to-day one of the chief obstacles in the way of the practical operation of any form of electrical street railway. It requires much and careful study on the part of electrical engineers. This difficulty has driven most of the electrical railway conductors overhead on poles, making these systems impracticable for large cities. A conduit system must eventually be laid in the streets of even small cities, the objection to overhead electric wires of any kind being everywhere on the increase. The inventor of an electrical railway must face this growing objection to the unsightly poles and wires, and put his conductors below the surface.

In wet, muddy streets, in a conduit which must be small and must be built of iron or stone to have the required strength, how will it be possible to insulate conductors, bare throughout their entire length and supported every few feet? Mr. Nesmith proposed to use an ordinary underground cable to be laid in the ground outside of the conduit—leaving the conduit for the passage of the current collecting brushes. Mechanical circuit closing springs were to be used in the conduit at intervals as before. By this arrangement only the exposed ends of the sections of the conductor at the circuit closers must be provided with careful insulation. This was a great step towards success with the conduit system. This change in the plan of the conductors made a new device for connecting the current gatherers necessary. It must consist of the long insulating bar to keep the circuit closers open, and also of some device for always diverting the current from the line through the motor on the car. At the same time it must neither short circuit the motor out of the line, nor open the circuit of the line, for in the first instance the motor would stop, and in the second the current collector and circuit breaker would be destroyed by flashing, and the insulation of the generator and underground wire would be endangered.

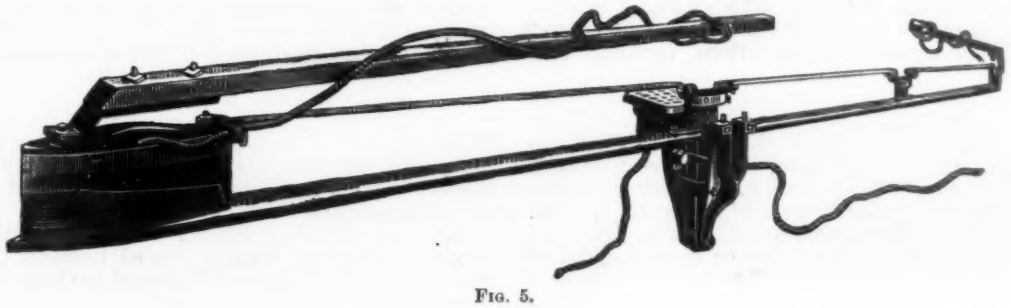


FIG. 5.

Mr. Short took this matter in hand and devised a very ingenious electrical current collector which has gained the name of "arrow" from its form. Fig. 3 shows the line with the current gatherer; fig. 4, the construction of the current gatherer, and fig. 5 the current gatherer in a circuit closer. 4, 5 and 6, fig. 4, are three sections of the underground cable connected with the two circuit breakers, B and B. If the current gatherer were removed from the breakers, B and B, these breakers would close and the line be continuous. This current collector is made of a slender bar of insu-

lating material somewhat longer than the section of the conductor between circuit closers. The metal strips, 1 and 2, are fastened around the entire edge of the insulating bar except at 3 and 3, where there are short insulated breaks in them as shown. Wires pass from these metal strips, 1 and 2, to the motor. The current passes into strip 2 from section 5 of the conductor through the motor into strip 1, and out on the other section at 6, as shown in the fig. The middle section, 4, of the conductor is cut out of circuit when the current collector is in the position shown in the fig. If the arrow be moved in either direction it will be seen that no flashing can occur, neither can the line be short-circuited. This current collector is 2½ inches by 1½ inches in section and about the length of a car. It is supported in the conduit by attachments passing down through the slot.

In November, 1885, this company put down on the same street 500 feet of the new line of insulated wire for one of these current collectors. It worked perfectly. During this entire winter of 1885 and 1886, this little line was worked in all kinds of weather—snow, rain, and mud—the track was flooded. The severest tests possible were made to prove its merits, and it never failed.

The Denver Electric and Cable Railway Company had procured from Mr. Short the right to use and manufacture for its own use all the electrical railway appliances of his invention in the state of Colorado. A new company, the United States Electric Company, comprising many of the gentlemen in the local company, was organised in August of 1885, for the purpose of developing Mr. Short's inventions. They secured his services as electrical engineer, and have arranged to own and control throughout the world his inventions, together with those of Mr. Nesmith.

In June and July of 1886 the new company put down under contract 3,100 feet of electrical railway, upon the last plan, for the Denver Electric and Cable Company. This track was laid on Fifteenth Street between the court house and the post office. Ordinary cross-ties were used, upon which were laid 20 pound T-rails. Notches were cut in the centre of the ties to form the conduit through which the arrow or current collector should pass. Planks were spiked to the ties covering the notches, except a small slot in the centre. The edge of this slot was protected by strap iron nailed to the planks. Under one of these planks was laid a Waring lead encased cable, with a conductor of No. 3 B. and S. gauge. Circuit breakers were placed every 25 feet, and the cable cut and attached to them. The two coaches built in Denver were placed upon the track. Each car had a motor of the Short type, made in Denver, and was supplied with both reversing gear and speed gear. Each motor weighed about 1,500 lbs. Tests were made of the efficiency of these motors when they were developing from 5 to 8 H.P., with a current of 25 amperes, and they showed an efficiency of 80 per cent., *i.e.*, for 10 H.P. of electrical energy put into them, they returned 8 H.P. at the Prony brake placed on the armature shaft. This is the average of many tests. The motors were placed on frames which were hung from the axles of the car trucks and carefully insulated from them. On the armature shaft of each motor was placed a raw-hide pinion. This pinion drove an iron gear on a countershaft which had its bearings attached to the same frame. The countershaft carried another pinion which meshed with the large gear of the driving axle of the car. This method of gearing was direct and positive, made little noise, and admitted of a simple and efficient reduction of speed from the motor armature shaft to that of the car axle. The small engine and dynamo first placed in the plant were used to furnish the power. On the 31st of July this road was started, and the car moved from one end of the track to the other without a hitch. This road was run constantly for three months, two men being required to operate it, one at the engine and one on the car. Only one car was run regularly as the line was so short. This car made six round trips per hour on a running time of 15 hours per day. No difficulty was experienced in operating this road. The success of the system and the enterprise was assured.

In the meantime, the Denver Electric and Cable Railway Company consolidated with another company, the Denver Railway Association, and the new company took the name of the Denver Tramway Company. This company contracted with the Denver Tramway Construction Company for the equipment of its lines with the improved system of electrical railway. The work was immediately begun, and 3½ miles are now fully equipped and in operation with seven cars. A new conduit of cast iron was used, and the slot narrowed to five-eighths of an inch. The conduit was enlarged to 7 inches by 5 inches and made more substantial and durable. As Denver streets are not paved it is difficult to construct a good road-bed. Large buildings have been erected, and a Lane and Bodley 16 by 42 Corliss engine put in place. A 100 H.P. Brush dynamo and a 100 H.P. Short automatic dynamo for constant current were added to the plant. Five Brush motors were placed under as many new cars, and the last of November the new machinery was started.

The road now in operation comprises some of the most difficult problems in electrical railroading. Starting as it does in the east-end of Denver, on top of Capitol Hill, a single track passes down a grade of 350 feet to the mile. At the bottom of the hill it crosses two horse car tracks, then curves into Fifteenth Street. When it reaches the court house it divides into a double track with automatic slot and track switches, which always turn the down car upon the right hand track. The double track continues for three-fourths of a mile, and on its way crosses five horse car tracks, two on curves. It then returns to a single track with automatic switches. This single track crosses five steam railway tracks, then enters a turnout, crosses another horse car track, and crosses the river as a double track on a bridge 200 feet long, two more steam railway tracks and another horse car track. Again it becomes a single track and branches into two lines, one going to the north, the other to the east, and climbs a grade of 350 feet to a mile, and about two blocks in length.

This line of track takes the cars across the city through the most densely settled business portion, where the traffic is heavy. The road has been running through the severest winter weather. A heavy snow fell soon after the road started, and snow plows were put on the cars, which cleared the track perfectly while making their regular trips. Each car is provided with sand boxes and sand pipes, and the track can be sanded from either end of the car by the driver.

The driver has a simple handle which is placed on an upright shaft in front of the dashboard of the car with which he controls the speed and reverses the motion of the car. The cars pass a given point going in the same direction every 10 minutes, making an average speed of six miles per hour. However, cars have been run over the line at night when the streets were clear at the rate of 25 miles per hour.

The trucks and gearing, fig. 7, used in this system are of the simplest kind. The ordinary street car wheels and axles are provided with an iron frame supported upon spring pedestals. On this frame the motor is fastened. On the shaft of the motor is a pinion which drives a gear wheel on a short countershaft. This countershaft carries another pinion which meshes with a large toothed gear wheel keyed to the axle of the car wheel, the greatest difference between pinion and gear being as one to five. Very little noise is noticed. The motor and its mechanical connections being wholly mounted on the truck, independently of the body of the car, the system can be readily applied without remodeling materially the cars now in use on horse car lines.

The conduit shown in fig. 8 is so arranged as to admit of its being put down on existing horse car lines. It is only necessary to remove the pavement in the centre of the track, dig a trench down to the cross ties and put down the cast iron conduit, which is made complete in sections of 8 feet. Before the pavement is relaid the lead-encased cable is laid along at one side,

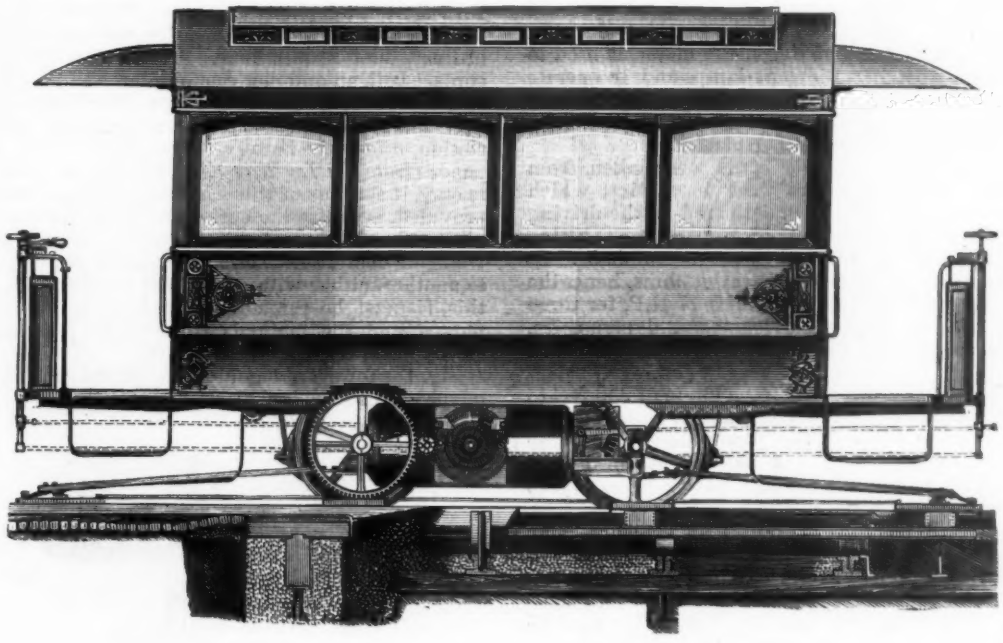


FIG. 6.—SHOWING SECTION OF CAR TRUCK AND CONDUIT, WITH COLLECTORS IN POSITION.

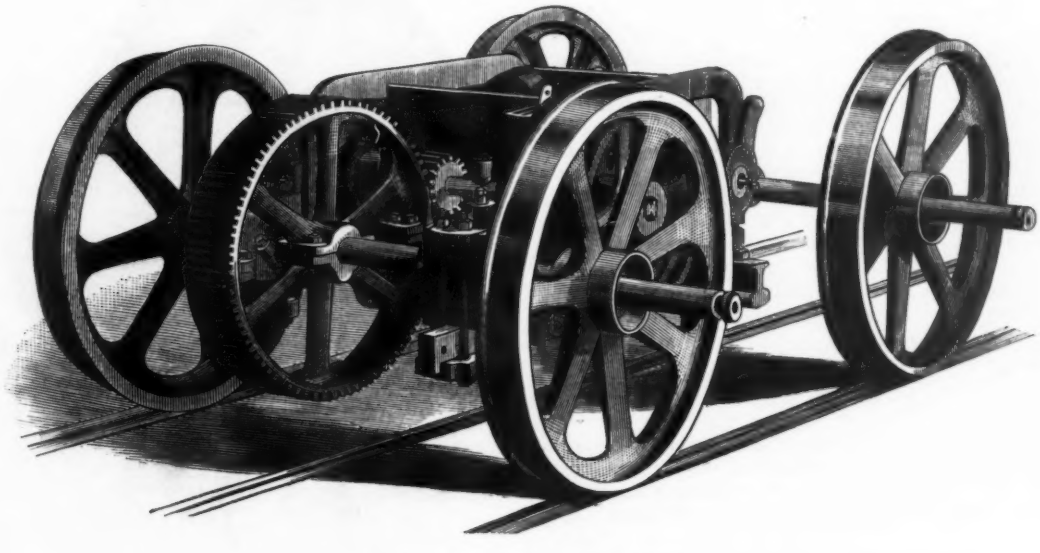


FIG. 7.—MOTOR TRUCK AND GEARING.

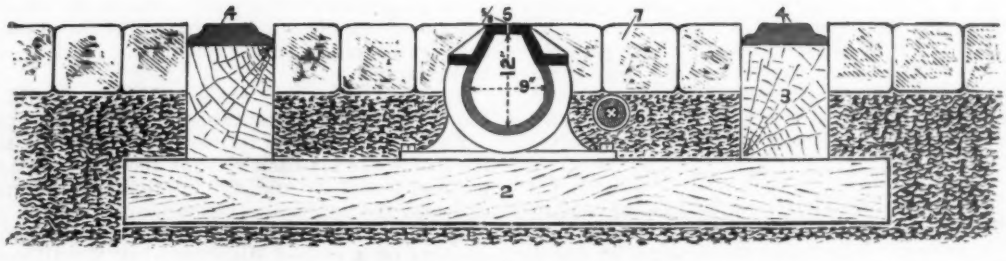


FIG. 8.—SECTION OF ROAD-BED.

2. Ties. 3. Strings. 4. Rails. 5. Slot in Conduit. 6. Cables. 7. Pavement.

as shown in the cut, all insulated and complete. The change from horses to electricity can by this method be made without interfering with the traffic of the road in the least.

The same current which feeds the motor is used to light the cars with incandescent lamps and to operate an alarm bell to warn persons of the approach of the cars. The cars can be moved forward or backward, and can be governed from either platform.

A few days since indicator cards were taken from the engine while three cars were in service, which showed an average of 32 H.P. delivered to the driving belt. A constant current of 40 ampères was passing over five miles of No. 3 B. and S. gauge conductor.

The resistance of the circuit is seven ohms, hence the circuit alone used 15 H.P., which left 17 H.P. for three cars, the friction of belting, shafting, dynamo, &c. This gives an average of 5·66 H.P. as necessary for each car.

One of these cars was climbing a grade of 350 feet to the mile at the time of the tests, and it is safe to say that it was using one-half the power delivered to the cars. Each car can be run at the expense of 5 H.P. delivered at the engine after the power necessary to overcome the line resistance has been deducted.

A good Corliss engine will deliver 5 H.P. for one hour with the consumption of 15 lbs. of coal, so it will require for each car 300 lbs. of coal per day of 20 hours. At $3 per ton the fuel for each car will cost 45 cents per day. It will require a constant expenditure of 15 H.P. to send the current over the line, and this amount will not vary with the number of cars on the line. This will cost $1.50 per day for coal.

The conductor used in this city is too small, as it was intended for a 30 ampère current, and was not changed when the 40 ampères were adopted, so the loss on the conductor is abnormally large.

The economy of this series road can be realised better when compared with the same system of tracks and conductors where the cars are run in multiple arc.

Suppose the same conductors be arranged in parallel, and the cars placed in derived circuit upon them. The average resistance could then be reckoned as 3·5 ohms (as with all the cars at the centre of the line), 40 ampères being required to run each motor.

Power required for	Multiple Arc.	Series System.
1 car	12¼ H.P.	20 H.P.
2 cars	40 ,,	25 ,,
5 ,,	212 ,,	40 ,,
10 ,,	800 ,,	65 ,,
20 ,,	3,102 ,,	115 ,,
40 ,,	12,210 ,,	215 ,,

It may seem unfair to compute the power necessary to run cars in multiple arc, using such small conductors as No. 3, but large conductors cost more, and the series road runs with great economy with the small conductor.

In the series road the larger the number of cars the less the percentage of loss or waste on the conductor, which is just the reverse of the multiple arc system. This seems to be the one thing which excludes the multiple arc system of electrical railway from large systems where a great number of cars are in operation.

The series system is the only one which is applicable to long lines of street cars where there are large numbers of cars in service. The results obtained in Denver prove that by using this series system, electricity becomes the cheapest motive power for street railways.

Firing a Gun by Electricity.—A change is about to be effected in the mode of firing the "One o'clock gun" at Devonport. The gun will be placed in direct communication, by means of a wire, with the electric clock at the station, Mount Wise, which is controlled direct from the Greenwich Observatory, so that simultaneously with the dropping of the ball at the semaphore the gun will be fired by electricity.

DR. C. HERZ'S BUTTON MICRO-TELEPHONE.

THE button telephone, as our readers may remember, is designed as a substitute for the call buttons in ordinary bell installations. It is a combination of a contact bell, an automatic commutator and a telephone, which serves alternately as transmitter and receiver.

It may, in fact, be called a complete telephonic station, *minus* the battery. The object of the present paper (from *La Lumière Electrique*) is to show that it is easy, if stations of this kind and a central battery are provided, to utilise the current of such a battery for supplying the microphones of different stations, and that we make communication at will from one instrument to another, either with or without a central office. All this, it must be remembered, relates to domestic telephony, and the methods cease to be practicable for great distances.

Fig. 1 shows an outside view of the button micro-telephone in its actual size.

FIG. 1.

The apparatus consists of two parts, one of which, fixed in general to the wall, contains the microphone and the automatic commutator, whilst the other, which is movable, contains the telephonic receiver and the bell button.

The two parts are connected by a flexible band. Fig. 2 represents the movable portion taken separately.

Figs. 3 and 4 give a front view (partially showing the inside) and a back view of the fixed portion, containing, as already said, the microphone, the induction coil and the automatic commutator. Fig. 3 gives a good idea of the construction of the microphone. It consists of a carbon diaphragm of 2 millimetres in thickness, placed at the distance of 1½ millimetre from a block, likewise of carbon.

The contact of variable resistance is formed by a group of small carbon rods, which play into sloping apertures. The rods rest at their positive end upon the

carbon diaphragm by their own weight, and that of the small balls of lead by which they are surmounted.

Upon the block of carbon, just mentioned, is placed the induction coil. The carbon diaphragm is perforated at the extremities of its horizontal diameter by two apertures, through which issue two small hooks, which serve to work the automatic commutator.

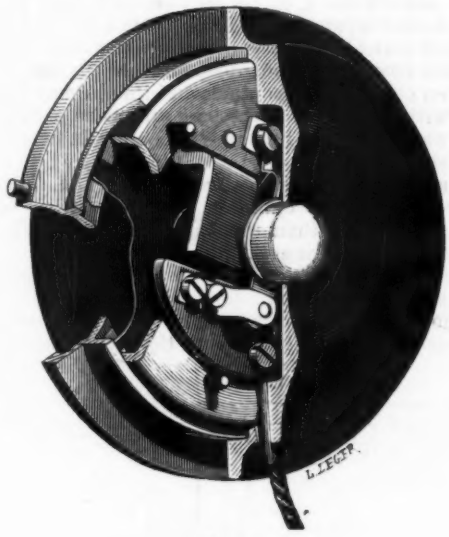


FIG. 2.

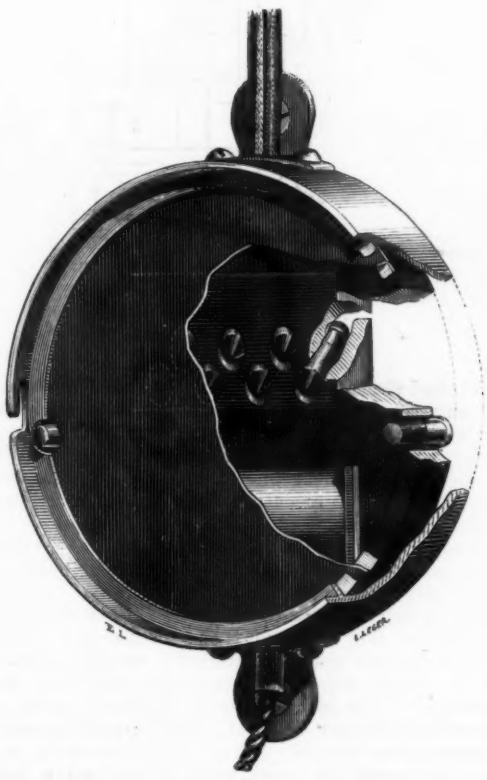


FIG. 3.

To understand the action of this automatic commutator (the parts of which are placed, as shown in fig. 4, upon the back surface of the stand) it is well to refer to the diagram, fig. 5, which shows the connections between two micro-telephonic stations supplied by a single battery, which we may suppose placed between the two stations. The commutator is an elastic brass rod, T, placed horizontally upon the posterior surface of the apparatus. By the play of the hooks it is moved forwards on unhooking the button telephone, and backwards when it is replaced upon its stand.

In the diagram, fig. 5, the station No. 1 is supposed to call to station No. 2. The call button (fig. 1) is pushed inwards, which causes the spring, *b* (station 1), to press against the screw, *v*, thus suppressing the contact, *r*, putting the bell of the post No. 1 out of circuit and closing the circuit through the bell of station No. 2.

It is easy to see that we have a closed circuit proceeding from the positive pole of the battery and passing through the wire, B, the commutator, T, the station No. 2, the pallet 1, the springs, *r* and *b*, of the same station, and returning to the negative pole of the battery by the wire, A, the spring, *b*, the screw, *v*, of station No. 1 and the wire, C.

When we remove the button telephone the bell is thrown out of circuit by the movement of the commu-

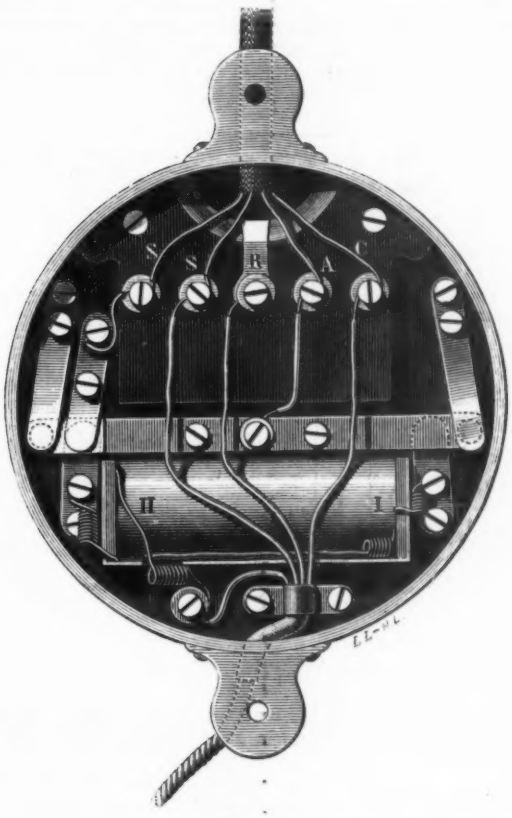


FIG. 4.

tator, T, which leaves the pallet 1 and forms contact with the pallets 2 and 3, thus closing the primary circuit and the secondary circuit of the induction coil I. and II.

The primary circuit is established as follows :—

From the positive pole of the battery to the wire, B, the commutator, T, to the pallet 3, then through the bobbin, the second extremity of which is connected to the carbon diaphragm ; from the diaphragm the circuit is completed by the variable resistance contacts and the wire, C, which communicates with the negative pole of the battery.

The secondary circuit passes through the pallet 2, the commutator, T, the wire, B, to station No. 2, then by the commutator, T, the pallet 2, the bobbin II., the recipient of this station, R, to the wire, A, returning to the recipient, R, of the station No. 1 by the bobbin II. and the pallet 2.

The play of the commutator, T, is secured by the method of grouping the movable and fixed parts of the button micro-telephone. As it appears in fig. 1 the two parts are connected by a bayonet joint. This

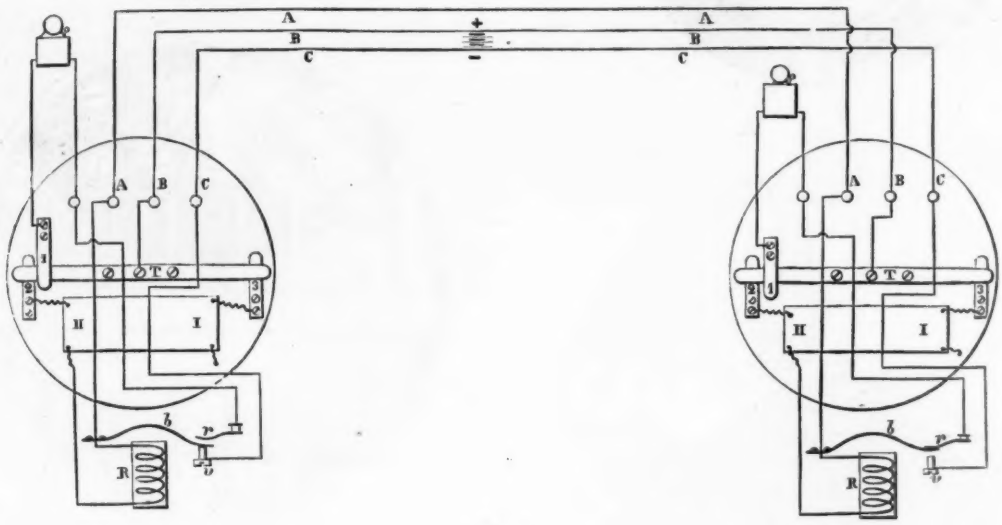
method of connection is very advantageous, for the two parts are very easily connected and disconnected. When the station is at rest the relative position of the fixed and movable pieces is always the same.

The case of fig. 5 is a simple case which will rarely occur in practice. It will be generally necessary to have a number of stations which must be capable of connection among themselves and with a single battery in such a manner that each may call any of the others. This problem admits of several solutions.

As soon as the number of stations exceeds a certain number a central office is necessary, and for this purpose the button telephone is well adapted. Such a system has been at work satisfactorily for more than half a year at the offices of *La Lumière Electrique*. The installation includes a battery of four Leclanché elements and 16 telephonic stations in the editorial, the printing, and the publisher's department and in the porter's lodge.

There is a modification of the button micro-telephone which avoids certain defects experienced in ordinary telephones and depending on the relatively considerable dimensions of the transmitter. To this end the transmitter is made in the shape of an elongated shell, tapering at one of its extremities and widened at the other. To the wider end is attached a cylinder and a mouthpiece.

We are indebted to the courtesy of Dr. Herz for the blocks with which we have illustrated this article.



STATION 1. FIG. 5. STATION 2.

AN EIGHT-LIGHT DYNAMO.

By GEORGE M. HOPKINS.

(*Continued from page* 421.)

THE making of a good commutator is not the smallest item in the construction of a dynamo. It is a very important part of the machine, requiring good workmanship and the best of materials.

The commutator cylinder in a machine of this class is formed of a series of bronze bars, separated a short distance from each other, and carefully insulated. On the 8-light dynamo it is 1½ inches in diameter and 2 inches long. The bronze sleeve, A, which is fitted to the shaft and provided with a fixed flange and a set screw at one end, is screw-threaded at the opposite end to receive the screw-threaded bronze flange, B. On the sleeve, A, between the fixed flange and the removable flange, B, is placed a vulcanite sleeve, C, and to the ends of this sleeve are fitted two collars, D, of vulcanised fibre or analogous insulating material. These collars are bevelled on their inner surfaces, and are thickest at their peripheries. To the vulcanite sleeve, C, is fitted a bronze cylinder, E, having conical ends, fitted to the bevelled collars, D, as shown at 5 in fig. 6. The bronze cylinder is slitted longitudinally in a gear cutter, or in any other convenient way, so as to divide it into twenty-four equal divisions, the slits extending nearly through the cylinder, as shown at 1. Before the bars are separated they are marked with figure punches, in regular order from 1 to 24, so that they may be rearranged after separation. Besides this, a sheet of mica is selected which can be crowded into the slits. Now, if the slits have been made deep enough, the bars may be broken off one after another, and the fin may be removed with a file; but if the bars cannot be broken off in this way, they may be removed by means of a hack saw, as shown at 2.

As many strips, F, of mica are cut from the sheet as there are bars in the cylinder, the mica strips being made a little wider than the bars and of exactly the same length, as shown at 3.

The commutator bars thus formed are placed between the collars, D, D, in alternation with the mica strips, with the bars arranged according to their numbers. The flange, B, is then screwed up tightly, clamping all the bars and the mica strips firmly in their places, each bar being thoroughly insulated. The cylinder thus made is placed upon an arbor and carefully turned off to bring it to a true cylindrical form. After turning, each bar is drilled near one end to receive the brass screw by which the armature wire is connected with the commutator bar.

The commutator cylinder, now finished, is secured in its place on the armature shaft, with the screws adjoining the body of the armature.

Now, for convenience in handling, the armature shaft is placed in the lathe, and the inside and outside terminals of one coil are carefully straightened out parallel with the sides of the armature, and their ends are stripped of the insulating covering for a short distance and thoroughly scraped. The screws in two of the commutator bars, say 1 and 2, are loosened so as to permit of placing the looped ends of two wires under them. The outer terminal of the coil is connected with one of the screws, and the inner terminal of the same coil is connected with the screw in the next bar in order in the commutator cylinder. The outer terminal of the second coil is connected with the screw last referred to, and the inner end is connected with the screw of the next bar in advance, and so on around the entire commutator cylinder, the outer end of each coil being connected with the inner end of the adjacent coil and with a bar of the commutator cylinder by one of the screws, as shown in fig. 7.

The brushes which bear upon opposite sides of the commutator cylinder are each made of six thin strips of hard rolled copper, $\frac{13}{16}$ths inch wide and 3 inches long, split from their free ends toward their clamped ends, to render them more elastic. The brushes are clamped in mortised studs passing through holes in the ends of a bar fitted to and adjustable on a boss formed on the inner side of the bronze yoke around the shaft. By this arrangement the brushes may be adjusted for taking off the current to the best advantage. The mortised studs which hold the brushes are separated electrically from the bar by insulating thimbles and washers, and upon the outer ends of the studs are screwed binding posts, in which are inserted conductors bent into spirals to permit of the adjustment of the brushes. One of these conductors communicates with one of the binding posts on the machine base, while the other communicates with one of the rods extending to the top of the field magnet. The remaining binding post on the base is connected with the other vertical rod, extending to the top of the magnet. These vertical rods are connected with the terminals of the winding of the field magnet, as shown in fig. 1.

The circuit of the machine is clearly shown in fig. 8, the current passing from the armature, C, through the upper brush, thence to the top of arm, A, of the magnet, down that arm, then up to the top, then down the arm, B, and up, then downward to the base of the machine, terminating at *a*. The lower or remaining brush is connected with conductor, *b*. From the terminals, *a*, *b*, the current is taken off for use.

In fig. 8, for the sake of clearness, only a single conductor is shown on the field magnet, but in practice there are four, each conductor passing down and up once on each arm of the magnet; that is to say, there are eight layers of wire on each arm of the magnet, formed of four wires, each wire being laid on by beginning at the yoke, winding down to the shoulder of the polar extremity, then up again to the top, leaving the inside and outside ends projecting, as shown in fig. 9. The winding is best done in a lathe.

In the present case all of the inner ends of the wires of the arms of the magnet are connected together, and all of the outer ends of one arm of the magnet are connected with one of the vertical rods, while the outer ends of the wires of the other arm are connected with the other vertical rod, as shown in fig. 1.

By winding the field magnet with No. 18 wire in the manner described, several advantages are secured, one of which is the facility with which the work of winding may be done; another is the possibility of connecting the wires in different ways, so as to secure more or less resistance in the magnet. Another is that the wires may be conveniently connected up according to the various methods of winding, compound, shunt, series, &c.

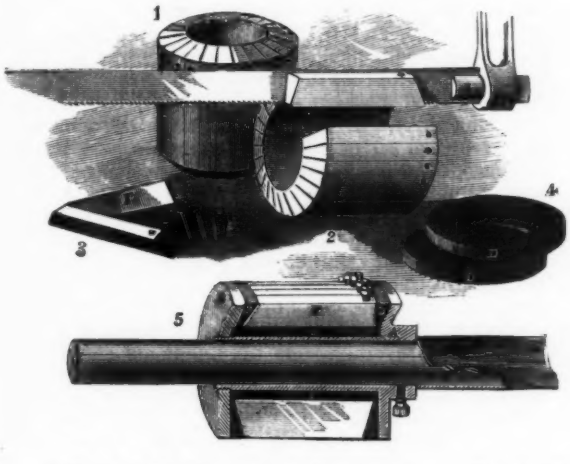


FIG. 6.—THE COMMUTATOR CYLINDER.

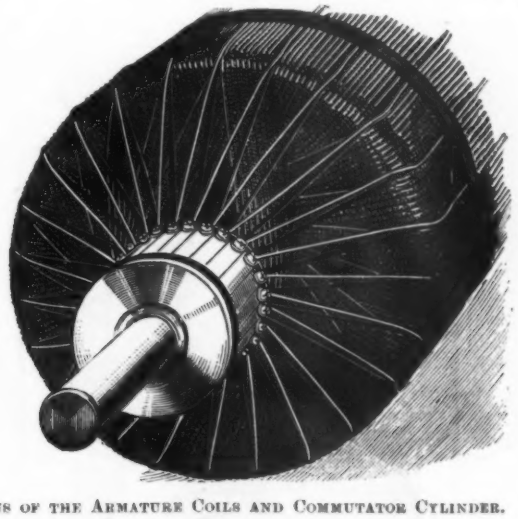


FIG. 7.—CONNECTIONS OF THE ARMATURE COILS AND COMMUTATOR CYLINDER.

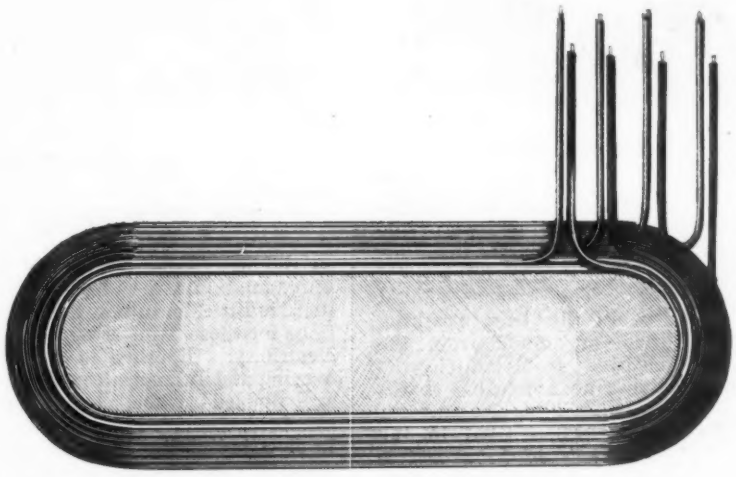


FIG. 9.—SECTION OF ONE ARM OF THE FIELD MAGNET, SHOWING WINDING.

As shown in the engravings, all of the wires of the field magnet are in parallel circuit, practically forming a large conductor of small resistance, and the conductor thus arranged is connected in series with the armature, that is, the current from the armature passes directly through the field magnet and external circuit.

Having made the dynamo and connected it up in the manner described, the brushes are to be brought into contact with the commutator cylinder at points diametrically opposite each other, and at points about opposite the centre of the space between the polar extremities of the field magnet. The armature is revolved in the direction of the free ends of the brushes, and in the binding posts on the base are inserted short wires, which may be brought into contact with each other momentarily as the armature revolves.

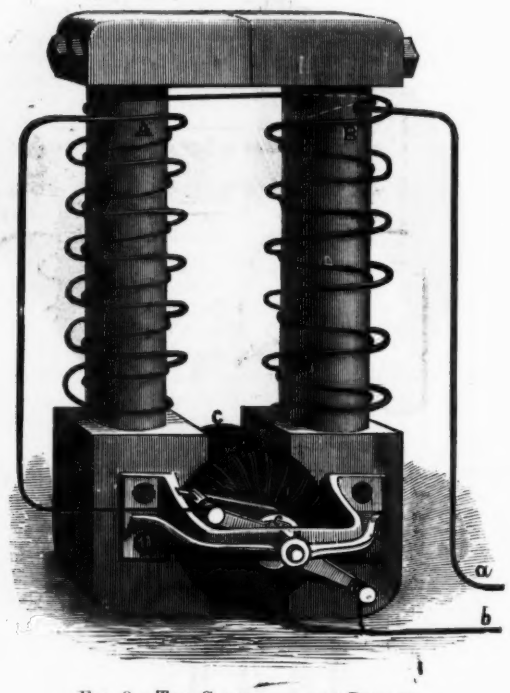


FIG. 8.—THE CIRCUIT OF THE DYNAMO.

If a spark is seen on the separation of the wires, it shows that the magnetism inherent in the iron of the field magnet is sufficient for the starting of the machine, and no further manipulation other than the adjustment of the brushes is necessary. The brushes should be adjusted to a point where the least sparking is produced. This will not vary much from the original position. The machine from which the engravings were made produces no noticeable sparks at the commutator.

If the machine fails to start, when tried in the manner above indicated, a battery of four or five Bunsen cells must be connected with the binding posts, or a dynamo may be used instead of the battery. It sometimes requires a few minutes to start the current, but as soon as it begins the battery should be removed. Some care is necessary in handling the conductors, as it is quite possible to receive a severe shock from this machine.

Gas Engines.—Our engineering contemporaries published last week a report of Prof. Unwin, which embodied the results of experiments made by that gentleman with a 4 horse-power (nominal) Atkinson gas engine. The motor is remarkable from a mechanical point of view, but to our readers it has a still more important bearing, inasmuch as it marks a distinct advance in the economy of the gas engine, the consumption of gas per actual horse-power being considerably less than in other and well-known types.

THE YORKSHIRE JUBILEE EXHIBITION.

THIS exhibition at Saltaire was opened on Friday last, the 6th inst., under very favourable conditions by H.R.H. Princess Beatrice, who was accompanied by Prince Henry of Battenberg. The directors of the Salt Schools, who are the promoters of the exhibition, had been untiring in their efforts to make a creditable start on the opening day, and the appearance of the exhibition when the Princess and the *élite* of Yorkshire walked through it on Friday showed that these endeavours had been in a great measure successful.

The electric lighting arrangements have been already described in these columns. It is only necessary to add that the lighting when brought into use on Friday night was, upon the whole, satisfactory, although here and there some unsteadiness was observable in the arc lamps. More perfect results seem to have been attained since, and if the elaborate precautions that have been taken against breakdown prove effectual, there is no doubt that the installation will do credit to the contractors.

In the exhibition there are several stalls connected with electrical science. The Woodhouse and Rawson Company show a number of brackets, shades, lamps, switches, pushes, and electric bells. Messrs. J. Davis and Co., of Bradford, have a display of lightning conductors of the most approved type, indicator cases for electric bells, and small clocks arranged to set off electric alarums at a given hour. The National Telephone Company, who have call boxes in every corner of the exhibition, show a model exchange in operation, and also exhibit several forms of telephones, and other electrical appliances. Their stand is surmounted by a standard upon which nearly every form of insulator and shackle may be seen, some of them a great deal more antique than the company itself. Messrs. John Roper & Co., of Bradford, have a very neat exhibit of dynamos and arc lamps, and the Postmaster-General has sent a number of telegraph instruments illustrative of the progress made in telegraphy since its introduction. The five-needle telegraph, patented by Cooke and Wheatstone in 1837, heads the list, and it is followed by specimens of every instrument that has played an important part in telegraphic evolution, up to the improved Wheatstone transmitter and receiver of to-day.

THE NEWCASTLE EXHIBITION.

OF the many shows to be held in different parts of the kingdom, in this the jubilee year of Her Majesty's reign, there is little doubt that the one possessing most attractions for those who are interested in the progress of electricity will prove to be the Royal Mining, Engineering and Industrial Exhibition at Newcastle which was opened so auspiciously by H.R.H. the Duke of Cambridge on Wednesday. The most recent advances in electric lighting and the most novel applications of electricity to various industrial purposes will be well and fully illustrated. As our readers are aware, the electric lighting of the Exhibition was placed by the Executive Council under the superintendence of a committee of specialists with Professor Garnett at its head. As soon as the erection of the building had been fairly started, the committee determined upon the distribution of the lamps in the principal courts and picture galleries, and invited tenders for the erection and maintenance of the installations. It was from the first the opinion of the committee that several systems of lighting should, if possible, be shown, so that the installations might form an interesting exhibit in addition to furnishing the light required. A considerable number of tenders were received; some for small sections of the Exhibition only; others for the whole amount of lighting required. Eventually five tenders were accepted, each system possessing its own characteristics, and the whole constituting a very impor-

tant exhibit, affording the means of making exact measurements of the relative efficiency of the dynamos employed.

A very excellent "Official Guide" has been issued, giving a description of the buildings and their contents and explaining the aim and scope of the Exhibition. From it we are glad to learn that during the time the Exhibition is open tests will be made upon the different systems exhibited in order to ascertain what amount of light can be obtained at the expense of 1 lb. of steam per hour at the working pressure, this, of course, depending on the combined efficiency of the engines, dynamos and lamps. Tests of this kind will be very valuable, and to both manufacturers and their customers much more satisfactory than the award of medals. At the dinner at the conclusion of the private view on Saturday last over which the Mayor of Newcastle presided, Alderman Thomas Gray paid a high compliment, but one which was well merited, to Professor Garnett for the amount of time, energy and scientific knowledge which he had devoted to the subject of the electric lighting of the Exhibition and said that to him was due the fact that at Newcastle they would have the most perfect system of electric lighting ever applied in any similar undertaking in the United Kingdom. In replying, Professor Garnett said that he thought the Exhibition was unique as an example of what local effort could do in the provinces. Something like two-thirds of the whole of the electric lighting had been done by local firms, and as far as he could see had been done well. It was the original intention and main object of the promotors of the exhibition that they should show the world what Newcastle and district could do, and that was their guiding principle both in connection with the electric lighting and the other departments of the exhibition. The firms who had lit the whole of the interior of the courts, the room in which they were gathered, together with the theatre and the picture gallery, were, he was glad to say, both local firms whose works were within a mile or two of the building.

For the convenience of exhibitors the lights inside the buildings were run on Saturday till 10 p.m., and everything appeared to be in thorough working order. The illumination of the main courts by Messrs. Clarke, Chapman, Parsons & Co.'s large incandescent lamps forms after dark one of the most striking features of the display, and is a bold departure from familiar practice. The lamps in the main courts are incandescents of 500 candle-power, and those in the subordinate courts 200 and 100, the general effect being everything that could be desired. On all hands it was admitted to be much more agreeable and satisfactory than arc lighting, the distribution being excellent and the steadiness perfect. The current for these lamps is generated by a range of 14 machines of uniform size similar to the one exhibited by Messrs. Clarke, Chapman, Parsons & Co. at the Invention's Exhibition, being a combination of engine or turbo-motor and dynamo and rotating at the rate of 9,000 revolutions per minute. In the theatre, which is to be used during the run of the exhibition for dramatic performances, there are arrangements for controlling the light which are said to be an advance byond anything hitherto attempted in this way, and the lessees, Messrs. Howard and Wyndham, are advertising it as "the only theatre in the world entirely illuminated by the electric light." A number of lamps on a special circuit are aptly designated "panic lights," and form a reserve ready to be immediately switched on in case of any accidental breakdown of the others.

The lighting of the picture gallery also presents features of interest, the 400 lamps of 16 C.P. employed being arranged upon specially constructed wooden frames rendered fireproof with white silicate paint which is a more intense white than asbestos paint and is equally good in resisting fire. The wire connections to the lamps in the theatre, art gallery, and dining rooms, are covered with asbestos specially prepared by Messrs. Phillips Brothers, of Hackney Wick. Messrs. Paris and Scott's demonstration of their system of distribution by transformers will be another interesting item of the lighting arrangements, but is not yet in working order. In the meantime, they are lighting a large area called the Inner Garden with a band stand in the centre, using their improved four-pole dynamos, which are said to be very economical and effective machines. Their new mode of construction, which consists in the insertion of broad bars of iron between the copper coils of the armature, thus making it into a modified form of the Pacinotti ring, has increased the output of the machines by 75 per cent., without adding to their weight. The total weight of the 30-unit dynamo at the exhibition is 17 cwt., including pulley, and at 900 revolutions gives 110 volts and 270 ampères. The resistance of the armature is ·016 ohm and of the magnet coils 16 ohms. The loss in armature is 3·9 per cent. and in the magnet coils 2·6 per cent., showing a net electrical efficiency of 93·5 per cent.

An interesting feature of the exhibition, and one that has been very well executed, is a model of the old Tyne Bridge, over an artificial river. This represents the bridge which existed in 1305, when Sir William Wallace having been executed in London, one of the quarters of his body was sent to Newcastle for exposure on the gate of the bridge. This bridge—which is something like to what old London Bridge is represented to have been, with houses and shops on each side—will be tenanted by exhibitors. The electric lighting of this structure and other erections in the North Gardens was entrusted to Messrs. Nicholson and Jennings, of Old Kent Road, London, who use lamps of 16 candle-power, fed from Victoria machines. Messrs. Woodhouse & Rawson supply the arc lights for the gardens and the turret over the principal entrance, but the local papers are calling attention to the fact that the only portion of the electric lighting not ready for the opening night was that entrusted to a London firm, the local people having, on the other hand, completed their work days before. This probably is a very unfair criticism, the circumstances of the cases being entirely different. Messrs. Woodhouse & Rawson will run in all 83 arc lamps of a type they are introducing under the name of the "Diamond," and worked under the patents of Scharnweber. They point out that the chief point of excellence about this lamp is its extreme simplicity and ease of management, and also the fact that the light maintains a central position in the globe during the whole time of burning. Each of the lamps takes a current of 10 ampéres at an E.M.F. of 50 volts. To avoid a high potential, which the Electric Lighting Committee of the Exhibition do not approve of, the lamps are being run in series of four, each group of four being in parallel with the other groups. In the turrets there are four large arc lamps, each of 20 ampères, and the group running as before in parallel with the smaller arc lamps. The 83 10-ampère lamps and the 4 20-ampère lamps, are run off one large dynamo capable of giving an out-put of 50 units at about 500 revolutions, and the dynamo is compound wound so as to rise in potential from about 210 volts, when no current is being taken from the machine, to the full 220 volts with the maximum amount of current. This makes up for the resistance lost in the leads and also makes the whole system practically self-regulating. Two sets of dynamos are being provided so as to guard against any breakdown of the machines, which are joined up to a switch-board from which the various lamp circuits are taken, so that one dynamo can instantly take the place of the other should there be any necessity for it. Messrs. Woodhouse and Rawson are also lighting part of the engine room with five Jablochkoff candles running off an alternating Gramme machine. This same Gramme machine is to be used with three Gaulard and Gibbs patent secondary transformers for lighting some incandescent lamps at a great distance from the engine room, and is also being used in connection with a transformer, made by the United Electrical Engineering Company, for showing the new processes of electrical welding. As this will be exhibited all day long,

the public will have an opportunity of comparing the rapidity with which welds can be made by electricity against the time it takes with an ordinary forge which is close at hand.

Full details of the lighting arrangements of the exhibition appeared in the ELECTRICAL REVIEW of April 15th, and in future numbers we hope to have something to say as to the manner in which the various systems work.

THE ROYAL JUBILEE EXHIBITION, MANCHESTER.

THE general business and other comforts of exhibitors and visitors to this exhibition have been well looked to from the commencement, and indeed from before the opening, as for some considerable time an exhibitors' club has been established. A building has been, by the kindness of the executive, found for them in the gardens or grounds of the exhibition, and as the subscription is moderate many exhibitors have joined. We take this opportunity of informing those of our readers who may visit the club, that the ELECTRICAL REVIEW may be seen there, as a copy has been forwarded regularly.

Excellent provision has been made for the indispensable postal, telegraphic, and telephonic services, the last named being more than usually excellent and well provided. The post office is situated at the south-east angle of the dome, near to the Talbot Road entrance to the exhibition, and at the foot of the staircase leading to the machinery annexe. The postal arrangements are of the usual branch office character, and two wires are provided for telegraphic messages. On the roof of the office is an exhibit (216 A.) of the Postmaster-General, consisting of "Telegraphic apparatus used by the various telegraph companies prior to the acquisition of the telegraphs by the Government in 1870. Also the modern apparatus now in general use by the Post Office, and specimens of submarine cables." The instruments number amongst them the oldest form of double needle (Reid Bros.), Highton's single needle, Morse embosser, Henley's magneto instrument, the Siemens ink-writer, used by the United Kingdom Telegraph Company, also their single needle, Wilde's magneto A B C, Bright's bells, with the most modern form of bell-plate sounder; there are other new forms of single needle, direct writers, and a complete set of Wheatstone automatics, with punchers, &c. A telegraph pole exemplifies the various forms of insulators, and a syphon recorder, with specimens of post office submarine cables, and a model of the cable ship *Monarch* completes an interesting historical exhibit.

Just outside the post office is the public telephone call office, and also the switch-room of the Lancashire and Cheshire Telephonic Exchange Company, Limited. The switch-room is a very handsome room of polished American walnut, closed in and protected on all sides by plate glass. It is perfectly open to the view of visitors, so that the interesting process of switching on subscribers by the lady operators can be readily watched.

Many will be surprised—especially those in London who are used to the London system—at the rapidity with which the telephonic business has been got together in this one place, and how quickly the electrical and other arrangements have been completed. In addition to the connection by trunk lines with the central exchange in Manchester, there has been established a local exchange, as well as numerous private telephonic lines in the building itself. The exchange numbers as many as 53 subscribers in the building, requiring as much as 3½ miles of wire to complete the connections, and there is every probability of further increase. This exchange therefore possesses more subscribers than many towns of large size. In addition to subscribers there are 18 private telephonic lines in the building absorbing 1½ miles of wire; this, therefore, gives a total of 71 instrument sets in the building with 5 miles of wire connecting them. The well-known partiality of local business men to the use of the telephone induced the manager of the company to make what was considered to be ample provision for telephonic communication between the Exhibition and the Central Manchester Exchange, and accordingly 20 trunk lines (representing 60 miles of wire) were erected, and we are assured that even with this service great pressure is felt at times, and the capacity is hardly sufficient even at this early period. Four public call boxes have been provided, and these are in almost incessant demand, and at times the applicants have to wait for some time. These call boxes will shortly be fitted with Poole and MacIver's automatic call arrangement which has been found to answer so well elsewhere. In the switch room are arranged various samples of telephone apparatus showing different receivers and transmitters, including one of Edison's with the "chalk" receiver, and other interesting articles in connection with telephony, amongst which may be especially noted the "Multiplex" telephone, which is in successful use in various parts of Manchester. On the wall of the building above the switch room is a large map, delineating the various lines of the company throughout Lancashire and Cheshire, and showing also the connections of the system with that of the National Telephone Company. The switch room is lighted in the evening by incandescent lamps, fixed by the Manchester Edison Company, and worked by them in connection with other exhibits in the building from their dynamos. This telephonic exhibit is of a most interesting character, and great praise is due to the company and its manager, Mr. MacIver, for supplying their subscribers and the public with such excellent business facilities, and we must not omit to mention the rapidity with which the extensive work has been completed under the superintendence of Mr. J. Clark, the company's engineer, assisted by the electrician, Mr. Poole. We should have mentioned that one of the switch-boards in use is a compact one of the American Western Electric Company's pattern, and the other of the "sliding" bar arrangement.

The incandescent lighting of the Fine Arts Section was started for the first time on Monday evening last, when the galleries were kept open until 9.0 p.m., and worked as successfully as could be desired. The arc lighting also shows a decided improvement, the number of lamps now in position exceeding 400.

REVIEWS.

Chemistry for Beginners: Adapted for the Elementary Stage of the Science and Arts Department's Examinations in Inorganic Chemistry. By R. L. TAYLOR, F.I.C., F.C.S., Teacher of Chemistry and Physics in the Central Higher Grade Board School, Manchester. London: Sampson Low, Marston, Searle & Rivington.

Although this book consists of but a little over 100 pages, yet the author has contrived in this small space to compress a large amount of information. The book is divided into nine chapters, with the respective headings, "Introduction," "Oxygen," "Hydrogen," "Compounds of Hydrogen with Oxygen," "Nitrogen," "Compounds of Nitrogen," "Carbon and its Oxides," "Chlorine and its Compounds," "Sulphur and its Compounds." The range, it will be seen, is not very extensive, but it is sufficient for students who are studying for the elementary stage of the Science and Arts Department's examinations in inorganic chemistry. At the end of the work a number of questions and problems are given, and these are so arranged that there is a set corresponding to each chapter. Although no answers to these questions are

given yet the student would have no difficulty in finding the replies by referring to the chapter to which they have reference.

Practical Electric Lighting. By A. BROMLEY HOLMES. Third Edition. London: E. & F. N. Spon, 125, Strand.

In our review of the first edition of this work, published in 1883, we were able to speak in high terms of Mr. Holmes's production; by the addition in the present edition of some 20 more pages and 25 more illustrations, the utility of the original work has been considerably enhanced. A great feature in the book is its conciseness, so that we have a very great deal clearly explained in comparatively few words. The general style in which the book is got up is decidedly attractive.

Journal of the Society of Telegraph Engineers and Electricians. Nos. 65 and 66. London: E. & F. N. Spon, 125, Strand.

These numbers of the society's journal contain the "Inaugural address" of Sir Charles Bright and the following papers read before the society: "Telephonic Investigations," by Prof. Silvanus Thompson; "On Reversible Lead Batteries, and their Use for Electric Lighting," by Mr. Desmond FitzGerald; and "The Resistance of Faults in Submarine Cables," by Mr. A. E. Kenelly, together with the discussions on the same. The usual extracts conclude No. 65, whilst at the end of No. 66 we have a valuable "List of Articles relating to Electricity and Magnetism, appearing in the principal English and Foreign Technical Journals, &c.," though for what period is not definitely stated. A first list of subscribers towards the "Imperial Institute" and the "Telegraph Jubilee Fund" is given; the amounts received in the two cases being £133 and £122 respectively.

IS ELECTRICITY MATTER?

THE following letter has been addressed by Mr. Carl Hering to the *Electrical World*:—"Sir,—During the past few years I have advanced the following argument to a number of electricians, and having failed to find any one who can bring up any argument against it, I thought it might be of sufficient interest to be discussed in your paper. Possibly it may not be new, but I have never seen it published anywhere.

"I believe it is conceded that everything in the universe is either force or matter; therefore electricity must be one or the other. If it is matter it must remain the same in amount and can never be consumed or generated. If it is force it may be generated by the expenditure of another force, as of a steam engine, for instance, and it will then *grow less in amount* as it is again converted into other forces, as in motors, lamps, storage batteries, or in heating wires. Now it is a well-known fact that quantity of electricity measured in coulombs never is generated, never is consumed, and never does growless in the circuit, barring leakage. The current flowing out of a lamp is exactly the same in quantity as that flowing into it; the same is true of motors and of generators, showing that electricity itself is neither consumed while doing work, nor is it generated; after doing work in a lamp or motor it comes out in precisely the same quantity as it entered. Connect one pole of a battery to a circuit and you will have no current. Why? The battery is not able to *generate* quantity or coulombs of electricity; all it is able to do is take the quantity which flows in at the negative pole and to send it out at the positive pole with an increased *pressure*, or electromotive force. The battery, therefore, does not generate electricity, but merely raises the pressure of the electricity. Electricity is, therefore, not force, but matter. It is precisely analogous to water in a water circuit. The water is neither consumed nor generated. The pump merely increases the pressure of the water which flows in at one end; the water motor merely consumes this pressure again and converts it into mechanical work of another kind, it does not consume the water. The quantity of water measured in units of quantity is the same in all parts of a closed circuit of water.

"Perhaps it will be proved at some future time, as has been already suggested, that electricity is the ether (which is matter), whose wave motions are light, and which in some other form of motion is an electric current. Perhaps a current of electricity is the bodily conveyance of ether, as distinguished from a wave motion, which is light. In that case I would suggest that perhaps the relative motion of the ether of space and the revolving earth may explain the cause of the earth's magnetism. The magnetic polarity and direction at the equator are in accordance with such a theory, and the fact that the lines of force bend down into the earth at the magnetic poles may be explained by the well-known fact that lines of force are continuous circuits; they must return somewhere, and they select the axis of the earth, as there is no motion there to develop a counter magnetism. They cannot return outside of the earth, as lines of force cannot intersect each other, and in order to return outside of the earth they would have to intersect, as can readily be shown. Furthermore, observations show that they do not return outside of the earth.

"The only plausible arguments which I can find against the theory that electricity is matter, are that it may be a combination of force and matter, as for instance a wave motion; or it may be that the real current is in the *same* direction in both wires leading from a machine, therefore the electricity may emanate from this machine and consequently be force."

THE SOUTH KENSINGTON ELECTRIC LIGHTING.

THE *Financial News* of Tuesday in an article called "The South Kensington Moloch," proceeds thus:—

"The first of the series of Exhibitions might have been expected to cost more than any of its successors. It had a large amount of initial expenditure to incur—new buildings to provide, preliminary arrangements to make, and administrative services of various kinds to organise. The later Exhibitions had the benefit of much of its labour and expenditure. To mention only one or two items: it had to spend over £45,000 on buildings which they rented; it also spent fully £10,000 on electric lighting plant, which might also have been utilised by them, though, strange to say, every Exhibition found it absolutely necessary to have a new installation of its own. Whether this was dictated by peculiar ideas of economy, or by a wish to oblige certain electric engineers and contractors, the circumstance is noteworthy. The electric lighting bills of the three Exhibitions amounted, as will be seen below, to *over seventy thousand pounds*, and if that of the Inventories should prove, as it most likely will, up to the average of the rest, there will not be much left out of a hundred thousand pounds for this one outlay:—

Fisheries		£10,407
Healtheries	£23,140	
„ Gardens	2,858	
„ Fountains	2,733	
		28,731
Colonial	19,335	
„ Gardens	10,673	
„ Fountains	2,779	
		32,787
Total		£71,925

"In seventy thousand pounds there is, of course, latitude for a good deal of contracting, and all that contracting nowadays implies. In the electric lighting department there was always a goodly retinue of contractors about, and they had at least one amiable quality—they were ever ready to promote testimonials to "honorary members" of the staff. But amiability appears to be one of the virtues which is its own reward. Less obliging contractors might have found it difficult to run up bills for over seventy thousand pounds in so short a time, and for services which left such slight memorials of themselves. Had a perfectly new installation been made every year, and had all the plant and fittings been charged full price every time, the expenditure might still have seemed excessive. But each Exhibition passed on its surviving plant to its successor at a friendly valuation, consequently the later Exhibitions paid only second-hand price for much of their *materiel*. A great deal was also done on the hire system: dynamos were hired from the Edison-Swan Company and storage batteries from the Electric Power Storage Company. Notwithstanding all these convenient and economical arrangements, the cost of electric lighting, instead of diminishing as more and more of the old plant became available, steadily increased. It rose, like Mr. Gladstone's surpluses, by leaps and bounds, from £10,407 in the first Exhibition to £32,787 in the fourth."

THE COLONIAL DELEGATES.

A PARTY of delegates to the Colonial Conference, on the invitation of the Postmaster-General, on Thursday last week visited Woolwich, in order to inspect the Government Telegraph Depôt at that place.

On arriving at Woolwich the party were conducted over the telegraph works, and the various subjects of interest—such as the method of finding the whereabouts of a break in a cable, &c.—were explained to them. They were then taken off in boats to Her Majesty's telegraph ship *Monarch*, which started on a trip

down the river as far as Greenhithe. Luncheon was served on board under an awning.

Mr. RAIKES, in proposing the toast of "The Colonial Representatives," stated that the Imperial Conference had been a matter of historical import and world-wide significance. The vessel they were on belonged to the postal department of this country. It was, in his opinion, the use of the cable that would year by year tend to bind still closer the mother country and the colonies. There had been no more important discussion at the Conference than that of the cable communication which bound together the various parts of the Empire, and he was glad to have had the opportunity of meeting the representatives of the various parts of Her Majesty's dominions on one of Her Majesty's telegraph ships. The Postmaster-General had a special mission in developing the communications between England and her colonies. If Her Majesty's Government had not risen to the height which was desirable in these matters, they would now be kept in knowledge of those affairs by the delegates. He hoped the colonial delegates would give credit to the postal department for the most ardent wish to keep alive the national sentiment of the unity of the Empire.

Sir JAMES LORIMER, in responding to the toast, said the colonial representatives felt that the Conference had been highly beneficial to the interests of the Empire. With regard to the telegraphic communications, although no very practical results had been attained at the Conference, the discussions they had had would greatly help towards bringing about a better state of things in the future.

Sir W. FITZHERBERT (of New Zealand) then proposed "The Health of the Postmaster-General."

Mr. RAIKES, in reply, said he had endeavoured to meet the colonial representatives in a spirit of frank confidence and interchange opinions on subjects which interested the whole Empire. He thanked them all for their kindness in coming there that day, and hoped that the Conference, and perhaps even their meeting there, would be the means of establishing further friendly relations between the colonies and the mother country.

After lunch was over the party disembarked from the *Monarch* and returned by special train to London, which was reached soon after 4 p.m.

NOTES.

Lighting the Lyceum Theatre, Edinburgh.—On Saturday evening, at the conclusion of the performance, a trial was made of lighting the theatre by means of electricity. It will be remembered that when the theatre was originally opened the electric light was employed as an illuminant, but its continuance was not of long duration. Judging from the experiment on Saturday evening, says the *Scotsman*, the installation which has just now been completed bids fair to be a permanent and most satisfactory addition to the attractions of the Lyceum Theatre. It has been effected by the Anglo-American Brush Electric Light Corporation, under the superintendence of the district manager, Mr. Geipel. The installation consists of 200 incandescence lamps, which are used for the illumination of the interior of the theatre; and in addition there is provided, in order to illuminate the exterior, a powerful arc lamp capable of yielding an aggregate of 4,000 candles, which is specially arranged for working off the same circuit as the incandescence lamps. The engine is constructed on the patents of Mr. Raworth, of the Anglo-American Brush Electric Light Corporation, and has been elaborated with a view to obtaining a silent and economically working engine, such as this class of work especially demands. The light was brought into use for the first time at the performance on Monday evening.

The Electric Light at Bournemouth.—On Friday night Messrs. Mortimer, Shepherd & Co., concluded the first of their series of experimental electric lighting installations of the Bournemouth Pier, the system tried being the Pilsen, which was found to work remarkably well. On Saturday night a trial of the Thomson-Houston system was inaugurated, and this has, so far, proved as successful as at Taunton. Newlyn's Royal Exeter Hotel is lighted every night by a splendid arc lamp, placed at the summit of the tower, which has attracted large crowds of spectators and become one of the sights of the town.

Proposed Electric Lighting in Cork.—A special meeting of the Standing Committee of the Cork Corporation was held on Monday week, to consider the representations and estimates of Mr. D. O. Bate, of the firm of Laing, Wharton and Down, electrical engineers, London, respecting the Thomson-Houston system of electric lighting, with a view of ascertaining if the employment of such a system was practicable and less expensive than the present system of lighting the city by gas. Mr. Bate was called before the committee, and said that since the council meeting had referred him to the committee he had called upon Mr. M'Mullen, the city engineer, who had furnished him with particulars, on which he was able to base somewhat of an estimate as to the number of electric lights required to replace a certain number of gas lights. Approximately, 1,300 lamp posts carried a little over 1,300 jets, and the cost of their maintenance was £4,883. As against that, the corporation could probably profitably utilise 100 arc lights in a number of the streets of the town, leaving the small and crooked streets, which could not be lighted successfully by electricity, to be lighted in the present way. Basing his calculation at £24 per arc, the arcs would cost £2,400 per annum. At the lowest estimate each of these lamps would take the place of six gas jets. That would leave 700 gas jets in the small streets, which would cost, at the same rate, £2,629, and that, added to £2,400, made £5,030, as against £4,883 by the present system of lighting. That was an excess of £147. But in some places he could extinguish ten jets for one electric light, and, making allowance for this additional saving, he found the cost of lighting to be £4,654, £229 less than the cost at present. His estimates were based on the figures of the year 1885. The city was illuminated by gas, at an average of nine hours per night; and he reckoned for keeping the electric lamps alight for ten hours, the same as his firm usually reckoned for English towns. If the corporation would use oil in the smaller streets, like the Waterford people, they would gain £700 a year. The Lighting Committee of Waterford had accepted the tender of his firm to light the streets of that city for the next five years, and this was now awaiting confirmation by the council. After some discussion it was finally resolved "that Mr. Bate and the engineer select within the channels the sites for 100 electric lamps, Mr. Bate then to furnish an estimate for supplying and maintaining such 100 lights for three or five years; the engineer to ascertain exactly what number of the present gas lamps might be extinguished if those 100 electric lights were erected."—*Gas World.*

Ship Lighting.—The *Racoon*, one of the Archer type of torpedo cruisers, was launched on Friday last at Devonport Dockyard in the presence of some five thousand spectators. The *Racoon* is of a 1,000 horse-power above her class, and will make twenty knots an hour. She will be armed with powerful guns as well as torpedoes, and will have electric search lights.

Last Friday night a large company assembled on board the Tyne Steam Shipping Company's vessel, the *John Ormston*, to witness the starting of the electric light installation, just completed by Messrs. Clarke, Chapman, Parsons & Co., Gateshead-on-Tyne. The brilliancy of the lamps, and steadiness from stem to stern, was the general admiration of every one on board. The old vessel seemed quite new, and, as one of the visitors remarked, it was the first time the fine saloon had been seen.

The Temesvar Installation.—Negotiations are under weigh for handing the Temesvar installation over to the Anglo-American Brush Corporation. Mr. Cottam, who has had charge of the installation, under the International Electric Company, since it was first started, will, it is assumed, continue to act as manager under the new *regime*.

Town Lighting by Electricity in Moravia.—The town of Olinätz, in Moravia, is, *Industries* states, negociating for a central electric light station.

The Cost of Arc Lighting.—Mr. Bate, of the firm of Messrs. Laing, Wharton and Down, in submitting an estimate to the Cork Corporation, based his calculations on £24 per arc lamp. If Mr. MacCarthy can contract for arc lighting in Dundalk at the rate of £16 13s. 4d. per lamp, and make it pay, surely the proposed lighting in Cork could be profitably carried out at a reduced figure?

Electric Lighting in Vienna.—It is announced that the dispute between the Imperial and Continental Gas Association and the Vienna Town Council is in a fair way to be settled, and the Court Theatre is shortly to be lighted by electricity.

Electric Lighting in Belgium.—The Brussels correspondent of *Industries* gives the following particulars of electric lighting installations in Brussels and other Belgian towns:—At Ghent, Messrs. de Smet & Dhanis have an installation of 300 Edison lamps, supplied from an Edison dynamo. The customers to whom the light is supplied pay 12 of a penny per lamp hour, and the total receipts for the last quarter of 1886 amounted to 1,320 francs. The number of lamps broken during that time was 164, *i.e.*, over 50 per cent. of those fitted. The lighting of the Grand Place, at Brussels, is about to be altered. Four arc lights of 5,000 C.P., mounted in pairs on masts, like those in the Place du Carroussel, at Paris, will be substituted for the two lights at present in use. Instead of the present 12 H.P. gas motor, a 20 H.P. Benz motor will be used to drive a Gülcher dynamo, new pattern, having an output of 12,000 watts at 65 volts. All the four lamps will be in parallel, and each will receive a current of about 40 ampères. The installation of six lights on the Place St. Lambert, at Liège, has been commenced. The gas engine, which is used as the motive power, is placed in one of the cellars of the St. André Exchange. The Société Industrielle of Brussels has obtained the contract for lighting the trains of the Economic Railway by electricity; Gadot accumulators will be employed. The Parc, in Brussels, will be lighted by a number of arc lamps.

Incandescent Lighting in New York.—Speaking of the remark made by Mr. J. Zacharias, when describing in the ELECTRICAL REVIEW for April 8th the illuminations commemorative of the Emperor of Germany's birthday, to the effect that the time is probably not far distant when the number of incandescent lights in Berlin will be greater than that in New York, the *Electrical World* says:—"That may be, though we doubt it. The incandescent light is being adopted more rapidly in New York to-day than we ever knew it to be before, and some of the plans, of more than one system, now under consideration, and very soon to be carried out, would, we think, rather stagger Mr. Zacharias with their immensity."

International Telephony. — The telegraph departments of Switzerland, Austria, and Bavaria have come to an understanding regarding an international telephone line between Rorschach-Bregenz and Lindau. Telephonic communication is already established between the towns of Schaffhausen, Winterthur, Zürich, Aarau, and Basle. At the end of 1886, *Industries* states, there were in Switzerland 41 telephone networks, with 5,000 subscribers, the subscription being 150 francs (£6) per annum.

Telephony in the North.—On the 1st May, 1885, the Northern District Telephone Company had erected in the counties of Northumberland and Durham, about 90 miles of trunk wires. At the present time there are working satisfactorily about 850 miles, and in course of construction about 200 miles. A proposition is also on foot for connecting Newcastle with York, and thus giving communication with the whole of the towns in Lancashire and Yorkshire. In addition to this, private lines have been built for the following firms: Burnhope and South Pontop Colliery Company, roughly, 35 miles in length; Ashington Colliery Company, 25 miles; Trimdon and East Hetton Collieries, 17 miles; Wingate Colliery Company, 12 miles; Hamsteels Colliery Company, 7 miles; Littleburn Colliery Company, 3 miles; Bell Brothers, 3½ miles; North Biddick Colliery Company, 8 miles; Shildon Co-operative Stores, 3½ miles; and also a large number of shorter private lines. The number of new ground poles erected since the 1st May, 1885, is about 2,796. It is worthy of note that the Burnhope line, which necessitated the erection of 70 miles of wire and 11 miles of new route, was completed in the extraordinarily short time of 23 working days in January and February. In addition to this the number of exchange subscribers has been more than doubled, exchanges having been opened at Blyth, East and West Hartlepool, Stockton, Middlesbro, Darlington, and Durham, and all the old exchanges have been rebuilt with the most modern and improved switchboard apparatus. The number of local calls for the first week in May, 1885, was 3,818, the trunk calls for the same week being 373, making a total of 4,191. The number of local calls for the first week in May, 1887, was 9,325, the trunk calls for the same week being 3,159, making a total of 12,484, an increase of 8,293.

The Colonial Conference and the Telegraphs.—The subject of telegraph cables occupied the attention of the Colonial Conference on Friday last week, but we only know from the official reports that a paper was presented on "The Eastern Extension Telegraph Company," that further discussion took place as to the laying of a cable between Vancouver and Australia, and that "resolutions were agreed to." It was stated in Parliament last week that a practically verbatim report of the proceedings of the conference will be published. This being the case, the reason is not very obvious why sittings should have been held in such a rigidly secret manner.

Amsterdam Exhibition of Food and Cookery.—Great preparations are being made in Amsterdam for a great exhibition of articles of food and cookery, which is to be opened with considerable ceremony in that city in June next. A great deal of interest in the exhibition has been excited not only in Holland, but in Germany, Belgium, and France, whilst also a number of exhibitors are expected from England. Part of the exhibition grounds will be fitted up as a seventeenth-century town hall market place, fish market, &c., and a large square will be set apart for concerts and entertainments of a varied character. The exhibition will remain open from June till September. We have as yet no information as to whether electric lighting is to form a feature, but doubtless, as the promoters of the exhibition apparently desire to make it as popular as possible, the best of all good light will be diffused.

Smoke Consuming Apparatus.—The fact that static electricity discharging from points can be used to condense smoke and dust, has led Herr Pichler and Major von Obermeyer, of Vienna, to turn their attention to experiments, with the object of preventing or mitigating the smoke nuisance. In this work they have followed, to a certain extent, the experiments made by Dr. Lodge and Mr. Walker, in England; but instead of devising their apparatus for the condensation of lead fumes, they aimed at condensing the smoke of boiler and other furnaces. The first results of the experiments were submitted to the Vienna Academy of Sciences last year. The electric machine used was a static induction machine built by Töpler, but it was found to be of insufficient power. Messrs. Siemens and Halske are now building a very large electric induction machine, with which experiments on a much larger scale will be made.

Physical Society.—For the meeting of this Society, to-morrow, Mr. E. C. Rimington, a well known contributor to our columns, has prepared a paper on "A modification of a method of Maxwell's for measuring the coefficient of self-induction," and Professor Silvanus P. Thompson sends a note on "Transformers for Electrical distribution."

Temporary Lighting.—At the recent festivities held at Mynde Park, near Hereford, to celebrate the coming of age of Mr. Thomas Raymond Symons, the owner, electric lighting formed a very important feature of the illuminations. Shippey incandescent lamps of various shades of colour were arranged to harmonise with the decorations. The Gothic windows around the saloon were all draped with pleated plush and sateen, and from the centre of each was suspended 50 candle-power lamps, while the various shrubs and plants placed in the recesses were embellished with groups of fairy lamps run three in series, to equal the voltage of the main current, arranged for low resistance lamps of 50 volts. The drawing room and suite of reception rooms were profusely lighted by a new 15 volt lamp of 15 candle-power embedded in silvered stars suspended from the cornices around the rooms, the wires being covered with maiden hair and other choice ferns. On the lake were numerous small lamps floating on the water enclosed in coloured balloons, and maintained by Woodward's small portable accumulators. The order for this installation was only given to the contractors on the previous Saturday, and the plant had to be sent from London, the work being commenced at mid-day on Bank Holiday; and although the engines and dynamos had to be placed in position in the court yard, cables run and wiring completed, and lamps fitted and arranged, the installation was ready and completed by Wednesday evening in time for the ball.

Electric Lighting in Scotland.—Besides the lighting mentioned a fortnight since in these columns, we may remind our readers that Mr. Rankin Kennedy has established a central station for the supply of electric lighting in the village of Cathcart, a suburb of Glasgow. This station has been running successfully for a period of three weeks now, and the demands for lights already exceed the capacity. The system is that recently mentioned in the articles by Mr. Kennedy on "Electrical Distribution by Alternating Currents and Transformers," known as Dick and Kennedy's system. Mr. Kennedy has also just finished the lighting of two small steamers at Leith; the *Lord Morton* and *Edinburgh Castle*, and has two other steamers in hand, the *Tantallon Castle* at Leith, and the *Electra* at Port Glasgow. He has also in progress two 1,000 light alternating dynamos for another central supply station.

The installations on the *Lord Morton* and *Edinburgh Castle* were tested on Saturday week. These ships are fitted, the one with 35 and the other with 30 Swan lamps of 20 C.P. The dynamos are placed in the engine room, and are of the Kennedy new ironclad type, running at about 800 revolutions per minute, and driven by Archer engines, with Dick's patent guttapercha and canvas belts. The pendants are of neat design, silver-plated in the saloons, and fitted with cut-glass globes, and each with an independent switch for putting the light off and on at will. There is also a portable deck lamp with five pendants in a cluster, which will be of good service during the embarking and landing of passengers at night. The whole work of fitting up the installations has been carried out under the superintendence of Mr. James Campbell, representing Mr. Kennedy, and after various tests the work has entirely satisfied Mr. R. Young, superintendent, and Mr. Galloway, owner of the steamers.

The Society of Telegraph Engineers and Electricians Students' Meeting.—The first students' meeting was held in the society's library on Thursday, the 5th inst., Prof. W. E. Ayrton, F.R.S., in the chair. Prof. Ayrton briefly addressed the meeting, stating the objects of such meetings, and expressing his warm sympathy with the movement. Mr. J. Rance then opened the discussion upon Dr. Thompson's "Telephonic Investigations," and was followed by Messrs. A. H. Bate, A. C. F. Webb, Wordingham, E. Thomas, and Cooper. Prof. Ayrton replied to several questions and closed the debate. A vote of thanks to the chairman terminated a very successful meeting.

Candidates for F.R.S.—Amongst the fifteen candidates selected by the Council of the Royal Society and recommended for election at the ballot which takes place on the 9th of June, we notice the names of several gentlemen intimately associated with electrical pursuits, viz., Sir James N. Douglass, Professor J. A. Ewing, Professor George Forbes, and Dr. Oliver J. Lodge. In *Nature* of last week may be found the qualifications of each candidate.

The Use of Secondary Batteries.—Mr. F. Rose writes that since reading Mr. Reckenzaun's "Notes on Secondary Batteries" in the REVIEW, he has come to the conclusion that many contractors do not understand the batteries they employ in installations which they fit up. He cites an instance of an installation of 500 lamps where the proprietor of an establishment was charmed to find that he had a splendid light after the engine had stopped, but was not quite so pleased when some time later the lamps gave forth only a dull red glow. On examining the battery Mr. Rose found that there was no regulating switch, and there being 52 cells, the lamps, which took a normal potential of 100 volts, actually received more, the cells dropping eventually to below 2 volts each.

To Correspondents and Contributors.—We would once more impress upon our friends the necessity of sending in their communications as early in the week as possible. Letters for our correspondence columns should reach us on Wednesday afternoons at the latest, and none but the most important items of news received on Thursdays can appear in the REVIEW for the same week. All literary communications should be addressed to "The Editors," and not to any person by name; and all business communications should be addressed to "The Publisher."

The Railway and Electric Appliances Company, Limited.—On account of the unavoidable absence of Colonel Jackson, the chair was taken at the last meeting of the company by Lieut.-Colonel Elliot, one of the directors.

The Bentley-Knight Electric Railway.—In the *Electrical World* of New York for April 23rd, there appears what purports to be a copy of a communication said to be sent by the Bentley-Knight Electric Railway Company to ourselves in reference to Mr. Holroyd Smith's letter, which appeared in our issue of March 11th. Up to the present no such communication has reached us.

The Society of Arts.—This society has recently laid down an Immisch series wound electro-motor for lecture and general purposes. The field connections are arranged so that the coils can be coupled in series or parallel. This arrangement is necessitated by the variety of work which the motor has to do. The maximum output is three brake H.P. at 950 revolutions per minute. The E.M.F. required is 110 volts, and so the motor can be run in parallel with the incandescent lamps used to light the large hall. It is found to be a valuable addition to the society's plant, and enables many lectures to be illustrated in a very practical way.

Self and Mutual Induction.—Until the reading of the masterly paper which formed the inaugural address of Prof. Hughes to the Society of Telegraph Engineers and Electricians during his term of presidency, the attention of electricians generally had not been directed to the great importance of becoming practically acquainted with the phenomena of self and mutual induction. Even now it is probable that the conception of its meaning is, in many minds, but a hazy one; therefore we would urge that the paper which Profs. Ayrton and Perry brought last month before the above-mentioned society, and which is now appearing in our columns, should be attentively perused and mastered, for its importance cannot be over-estimated.

Street Illuminations. — At the recent visits to Manchester and Salford of the Prince and Princess of Wales, both cities were extensively illuminated on the evenings of the 3rd and 4th May, and in these illuminations both the arc and incandescent lamps formed interesting features. The splendid Town Hall of Manchester was a brilliant example of illumination by various devices, and the general effect was heightened by 18 arc lamps placed on the various pinnacles and other points of the building. Arc lights were employed at various places, especially by Messrs. Lewis, (who have an extensive electric lighting plant), who showed in one front as many as 28 arc lamps, and in the other 11 lamps. The best effect of the incandescent lamp was seen on the *Guardian* office, where a device was arranged with glow lamps. The effect was very brilliant; the large amount of light given out, together with the perfect steadiness of the light, rendered this device superior to that of any other. The incandescent light for the purpose of external illumination in this case showed a marked superiority to that of gas, for on the same building was a device in gas, which, owing to the influence of the wind, was particularly unsteady, and never complete in all its details, whilst the glow lamps remained ever steady, maintaining the device unaltered. Where buildings possess an electric plant, out-door illumination by glow lamps should be adopted in preference to gas for a perfect effect.

Practical Electrical Measurement.—Owing to our inability to procure on short notice the blocks with which Mr. Swinburne's third contribution to Practical Electrical Measurement is illustrated, we must necessarily leave the matter over till next week.

The Button Telephone.—The apparatus which we illustrate on page 442 of the REVIEW is, we believe, precisely similar to that which so completely fascinated and dazed the Paris representative of that technically accurate and highly scientific daily, the *Times*. That gentleman's enthusiastic outburst can be seen by referring to our pages for March 11th of the present year. For our part we have yet to be convinced that there is anything in this so-called invention of Dr. Herz which would warrant us in believing it to be possessed of any special value, notwithstanding that it is said to be manufactured for half a crown. We imagine that repairs would be frequent and cost many times more than the whole apparatus is worth, and we certainly do not see that the instrument can be used here without a license from the United Telephone Company. For domestic purposes, indeed, especially under the circumstances which now obtain in telephony, we should be inclined to prefer the mechanical telephone.

Secondary Generators.—We have received from M. Gaulard a long letter which would occupy several of our columns on the subject of secondary generators. As it is written in French, it was quite impossible for us to translate and set the communication in type in readiness for this issue of the REVIEW.

The Abdank-Deprez Apparatus.—We are compelled to leave over our illustrated description of the apparatus to which we drew attention in our last week's columns. We would, however, again remind our readers of the very complete sets of instruments, for various purposes, to be seen at 2, Austin Friars, E.C.

The Wiring of the American Exhibition.—We are informed that Mr. Musgrave Heaphy sanctioned the employment in this exhibition of what is called in America "Underwriters' wire," a material viewed not very favourably, we imagine, by wire coverers in this country, on the grounds that the show was "American."

Personal.—Our valued contributor, Mr. A. Reckenzaun, starts on Tuesday for New York, whither he proceeds on important business matters which will detain him there for at least four months. His papers on Secondary Batteries will, however, be continued at intervals, which will be as regular as circumstances permit.

Mr. P. J. Nelson has been selected for the appointment of Superintendent of Telegraphs for Penang and Province Wellesley, on six months probation.

The Stock Exchange.—This is the title of a new weekly journal for capitalists and investors, the first number being published last Saturday. The paper is promoted to supply that which is now considered a want, viz., a weekly record that shall be a practical reflex of the financial situation of the week. It will be edited with the co-operation, and under the personal supervision, of Baron Albert Grant. Of what value the journal may become, from a speculator's point of view, we cannot pretend to say, but the specimen number is decidedly more interesting, and its topics more varied, than is the case with the majority of financial papers.

Telegraph Supplies.—The Caledonian Railway Company, Glasgow, requires a supply of telegraph instruments. Specifications, and forms of tender, which must be lodged by the 23rd inst., may be obtained from Mr. W. Haig, Charles Street, Gt. Rollox, Glasgow. The Great Eastern Railway Company also, requires telegraph materials, the forms of tender for which may be had on application to the Secretary's Office, Liverpool Street terminus. Patterns may be seen at the Stores, Stratford, between 10 a.m. and 4 p.m., from the 18th to the 26th inst.

Reported Failure of the Electric Light.—We have been informed that the electric lights at the American Exhibition were not forthcoming on the opening night. Rumour also has it that the failure was due to a misunderstanding between the Exhibition authorities and the engine contractors. If this is so, the blame can hardly be attached to the lamps which, a correspondent informs us, were on Wednesday, working excellently both in the building and the grounds.

Electric Locomotion in Belgium.—The inauguration of electric traction on the Brussels lines has been arranged to take place this month, and five cars, according to *Industries*, have already been supplied by the Société l'Electrique. The installation in the Rue Bronier, where the accumulators are to be charged, is almost finished. It consists of De Naeyer boilers, a 150 H.P. Walschaerts engine, and four dynamos each for a current of 30 ampères, but varying in voltage from 200 to 500. The engine and boilers, the dynamos and the batteries, are all in different rooms. The battery room has been arranged so as to facilitate quick charging, and special arrangements are being made for the easy and rapid replacement of the batteries in the cars when these enter the station.

Electric Locomotion in Austria.—Messrs. Siemens and Halske, who are the contractors for the electric railway between Lend and Gastein, have obtained a concession from the Ministry of Commerce for a continuation of this line to Boeckstein.

Medical Use of Electricity.—Electricity is now being employed at two establishments in Paris for the treatment of disease. In one of these, states *Industries*, conducted by Dr. Vigoureux (the head electrician of La Salpetrière), there is a gas engine driving a dynamo machine, the current from which is led to a number of small electro-motors. These are used to work electrostatic induction machines, which are of English make, and the electricity generated is applied to the patients sitting in insulated chairs. A similar installation is in use at La Salpetrière.

The Pennock Primary Battery.—In the Pennock battery, which has just been brought out in New York, a patent compound in the form of a jelly is employed, instead of a fluid, as the electrolyte, and this is said to render it extremely convenient in regard to portability. Experiments have been made with it for lighting railway cars. It is claimed that the battery will last for three months without being recharged, and that the cost of lighting a car is 28s. per week.

Telegraphists and their Grievances.—Last Friday night, at the Foresters' Hall, Clerkenwell Road, there was a gathering of telegraphists from the central office and from the various districts of the metropolis to discuss certain anomalous conditions under which they allege they suffer as compared with other branches of the Civil Service. Mrs. Fenwick Miller occupied the chair, and pointed out five grievances, under which the 800 ladies of the central post-office suffered, viz., inadequate pay, insufficient holidays, lack of promotion from class to class, deduction of pay during sick leave, and demoralising effect of work. A petition to the Postmaster-General was resolved upon, and in this it was decided to state the many physical ailments to which telegraphists were subject, and from which the savings banks clerks were comparatively free. In short they asked, with their more arduous labours, to be put upon the same footing in regard to hours, pay, and privileges, as the employés of the savings bank department.

Cable Broken.—A telegram from New York dated May 7th, states that the French cable is broken near St. Pierre.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrified Rooms Company, Limited.—An agreement, dated 25th ult., relates to the purchase by this company of the undertaking and assets of the company of the same name, now in course of voluntary liquidation. The new company will take over the liabilities of the old company, and will issue 250 fully paid new shares, in respect of each share held in the old company. The agreement was duly filed on the 2nd inst.

Alfred Slatter & Co. (Electrical Engineers).—The first return of this company, made up to January 12th, was filed on February 4th. The nominal capital is £10,000 in £5 shares. 707 shares have been taken up. 400 are considered as fully paid, and the full amount has been called upon 207 shares, and upon the remaining 100 shares the sum of 12s. per share has been called up. The calls paid amount to £1,065 and unpaid to £30.

China and Japan Telephone Company, Limited.—The annual return of this company, made up to the 4th inst., was filed on the 6th inst. The nominal capital is £20,000 in £1 shares. 14,761 shares have been taken up, 14,719 of these are considered as fully paid, and the full amount has been paid upon the remaining 42 shares.

United River Plate Telephone Company, Limited.—The statutory return of this company, made up to the 29th ult., was filed on the 5th inst. The nominal capital is £500,000 in £5 shares. 49,738 have been taken up, 262 vendors' shares being as yet unallotted, making a total issue of 50,000 shares. Upon 15,738 of the allotted shares the sum of £78,690 is considered as paid up, and the sum of £170,000 has been received in respect of calls. Registered office: 53, New Broad Street.

Singapore, Straits Settlements and Siam Electrical Company, Limited.—At an extraordinary general meeting of the members of this company, held at the offices of Messrs. Woodhouse & Rawson, 11, Queen Victoria Street, on the 19th ult., it was resolved to make the following alterations in the Articles of Association:—

That article No. 80 be amended by inserting after the word "directors," the words "Colonel Sir Francis de Winton, K.C.M.G."

That article No. 83, clause 2, be amended by striking out after the word "office," the words "or do not acquire the same within three months after election or appointment."

That an article, to be numbered 83A, be added as follows: "83A. The directors shall have power to appoint any other persons to be directors at any time before the ordinary general meeting in each year, but so that the total number of directors shall not exceed seven."

The special resolution was confirmed on the 4th inst., and duly registered on the 6th inst.

The registered office of this company is situated at 3, Pancras Lane, Queen Street, E.C.

Hermite British Electro Bleaching Company, Limited.—An agreement of 20th ult., filed on the 26th ult., provides for the purchase from Eugene Hermite and Messrs. Paterson and Cooper of the following letters patent:—No. 5,160, A.D., 1883; 13,929, A.D., 1884; No. 3,956, A.D., 1886; 3,957, A.D., 1886, and 14,673, A.D., 1886; and the patent applied for on the 8th February, 1887, for apparatus for electrolysing bleaching solution. The purchase consideration is 1,000 fully-paid shares of £30 each, and £2,000 in cash, in respect of sums expended.

Cardiff Electro Bath Company, Limited.—At an extraordinary general meeting of the members of this company, held at the office, 72, St. Mary Street, Cardiff, on the 29th March, it was resolved to wind up voluntarily, and Mr. Samuel Hern was appointed liquidator. The resolution was confirmed on the 14th ult., and duly registered on the 27th ult.

Schmidt Douglas Electric Company, Limited.—The registered office of this company is situate at Hastlergate, Bradford, York.

Automatic Electric Railway Signal Company, Limited.—The registered office of this company is situate at 5, Exchange Station Buildings, Liverpool.

New Portable Electric Lamp and Power Syndicate, Limited.—The registered office of this company is situate at 41, Coleman Street.

NEW COMPANIES REGISTERED.

Electric Medical Appliance Company, Limited.—Capital, £2,000 in £1 shares. Objects:—To deal and trade in electrical appliances, trusses, and fancy articles generally in the United Kingdom and United States of America. Signatories (with one share each), F. H. Cowland, 111, Lansdowne Road, Kensington Park; A. H. Bowhill, 18, Gainsboro' Road, Bow; C. C. Frank, 1, Marian Villas, Penge; J. Laurie, Buckleigh Road, Streatham; C. H. Regnart, 24, Lichfield Grove, Finchley; E. Sait, Melfort Road, Lordship Lane, S.E.; A. P. Penmall, Cromwell House, Croydon. Registered 4th inst. without articles of association by Mr. Charles Doubble, registration agent, 14, Serjeant's Inn, Fleet Street.

J. G. Statter and Company, Limited.—£20,000 in £10 shares. To take over the business and assets of Messrs. John Grice Statter and Sydney Lionel Brunton of the Alliance Engineering Works, West Drayton, and of Middleton Road, Dalston, electric light and general and consulting engineers. Signatories: *W. Statter, Snapethorpe, near Wakefield, 100 shares; E. Ablett, M.D., Whitehaven, 50 shares; Mrs. M. E. Horsfall, Leamington, 100 shares; W. R. Statter, Wakefield, 20 shares; Mrs. W. Statter, 50 shares. *H. B. Statter, Snapethorpe, 20 shares; Miss M. P. Statter, 1 share. Directing qualification 20 shares. Mr. J. G. Statter is appointed managing director at a salary of £250 per annum. The remunera-

tion of the ordinary director will be £60 per annum. Mr. S. L. Brunton is appointed secretary and joint manager at a salary of £250 per annum. Registered 9th inst. by Messrs. Torr & Co., 38, Bedford Row.

CITY NOTES, REPORTS, MEETINGS, &c.

Submarine Cables Trust.

THE sixteenth annual ordinary meeting of the certificate holders in this trust was held at Winchester House on Wednesday, under the presidency of Mr. John Pender.

Mr. Lewis Wells, the secretary, having read the notice convening the meeting, and the report, which was printed in the REVIEW last week, having been taken as read,

The Chairman said the revenue for the past financial year amounted to £14,528 as against £21,826 in the previous year. This was mainly due to the falling off of the dividend paid by the Anglo-American Telegraph Company, from which they only received 5s. per cent. against £1 5s. in 1886. They had also had diminished return upon their other investments. The Eastern Telegraph Company only paid 5½ per cent. against 6 per cent., and the Eastern Extension Company 6 per cent. against 7. It would be observed that they brought into the past year's accounts £1,949, and carried forward a balance of only £95. They had in fact divided their revenue up to the hilt, not even retaining in hand sufficient to meet the expenses of the current half-year. Knowing that the interest on the coupons was cumulative the trustees wished to give the certificate holders as much as possible on account of the April account, as they did not see their way to pay the balance of 3 per cent. before October 15th. The expenses were £1,359 against £1,349, or £10 more than last year, this being necessitated by the extra cost of stationery and clerical labour in having to stamp the coupons in the office, work which was not necessary when the coupons were paid in full by the bankers. For the current year they hoped to receive at least 1 per cent. from the Anglo-American Company as 5s. last year, and it was also hoped that the Eastern Extension Company would again be in a position to pay 7 per cent. In that case, although they would not be able to pay the coupons in full, they would give the certificate holders a fair return on their investments. Speaking with regard to the war of rates in the Atlantic, he said there could be no doubt that that contest must terminate some time. As to when it would terminate he was not prepared to say, but having a strong belief that there was a period when it would be positively throwing away money to continue a war if all parties were disposed to terminate it, he hoped the termination was nearer than at present they were inclined to suppose. The reduction of dividends on the part of the Eastern Extension and Eastern Company arose from the very material reductions in the tariffs made at the Berlin Conference. Those reductions were the cause of reducing the income of the trust by a very considerable amount, something like £100,000, between the Eastern and Eastern Extension Companies. The telegraphs were discussed at the Colonial Conference recently, and the result, he thought, was to leave the companies in a better and a stronger position than they had occupied for a very long time. He was therefore hopeful that the traffic would continue to show that vitality which had been so remarkable a feature in the telegraphs, and that, both in the Eastern and the Eastern Extension Companies, they would go back to their old dividends. He hoped also that the Anglo-American war of rates would cease before he met the holders again. Altogether, he thought prospects were fair, and promised a return to such a revenue as would benefit the shares held by this trust so materially as to put them in a better financial position than they were now in. He then moved that the report and accounts of the trustees be approved and adopted.

Viscount Monck seconded the motion, which was unanimously agreed to.

The auditors, Mr. John G. Griffiths and Mr. John Gane, were re-elected, and a vote of thanks was accorded to the chairman and other trustees.

Brazilian Submarine Telegraph Company, Limited.

THE twenty-seventh ordinary general meeting of this company was held on Wednesday, at Winchester House, Old Broad Street, the Right Hon. Viscount Monck presiding.

Mr. Richard Collett, the secretary, having read the notice convening the meeting, the report of the directors, which appeared in the REVIEW last week, was taken as read.

The Chairman, in moving the adoption of the report and accounts, remarked upon the difficulty he experienced in devising new phraseology in addressing the shareholders. This was the twenty-seventh occasion within fourteen years upon which the obligation had devolved upon him of endeavouring to discharge the duty of explaining the position of the company; he therefore thought he had a right to claim their forbearance, for it was rather difficult to avoid being monotonous. The monotony of the past, however, had not been altogether of a disagreeable character. He thought there had been in the reports and addresses he had made to them, elements which had rendered the monotony satisfactory or at least palatable. He remembered that in the early days of the enterprise their proceedings were somewhat diversified by a not unnatural expression of impatience that the company had not at once realised all the anticipations formed of it. However, that was now a matter of history, for of recent years the proceedings had been tolerably amicable. Those who had read the report, which was a condensed history of the transactions of the company for the last six months, would see that the satisfactory elements to which he had alluded as existing in former reports were not wanting on the present occasion. They were able to report that the plant was all in excellent condition. They had had during the last six months a complete immunity from any casualties, and the traffic had shown a substantial increase both on the previous half-year and on the corresponding period of the previous year. He might incidentally mention that the increase of traffic was still going on, and that up to that day they were receiving considerably more than they received the year before. They had been able to pay their usual dividend, to add a very substantial sum to the reserve, and to carry forward a considerable sum to the current half-year's accounts. They had been threatened with competition in several directions, but the threats had not as yet assumed a tangible form. All he could say about them was that they were exercising the greatest vigilance as to the threatened attacks, and they would take such steps, in the event of their becoming tangible, as would in their opinion best serve the interests of the company. For a long period they had been engaged in negotiations for strengthening their position in Brazil, but those negotiations had not yet led to any practical result; they were not, however, without hope that they might do so, and in the meantime he must ask for the continued forbearance of the shareholders, for it was obvious that to disclose their hand, and to show what their operations were in the midst of a negotiation, would not be a wise or a useful course to pursue. He then moved the adoption of the report and accounts to December 31st, 1886.

Sir James Anderson seconded the motion.

A Shareholder asked what was the nature of the competition alluded to.

The Chairman said it could scarcely be called a competition, but there were several propositions to construct new lines which would practically compete with theirs. As yet they had not assumed a very decided form.

The resolution was then put and was carried unanimously. This concluded the business, and a vote of thanks to the chairman and board terminated the proceedings.

Anglo-American Brush Electric Light Corporation, Limited.—Respecting the issue of new capital to which we referred last week, the directors have addressed a letter to the shareholders, stating that the additional capital is required in consequence of the large increase in the corporation's business, the orders received during the first three months of the present year being double the amount of those received during the corresponding period of 1886. The Continental business of the corporation is also extending, and additional capital, the directors think, can profitably be invested in it. The Electric Lighting Act Amendment Bill introduced by the Chairman, Lord Thurlow, has already passed the House of Lords, and there is a good prospect of its becoming law this year. Under these circumstances the directors do not hesitate to recommend the shareholders to take up the shares now offered. The letter further states that, as it would be impracticable to specify the numerous contracts which have been made by the corporation, and in order to prevent any question under Section 38 of the Companies' Act, 1867, every allottee of shares shall be deemed to have taken such shares with full notice of all contracts, and to waive any further or other compliance with the enactment contained in the section referred to. Dividend will accrue on all payments as from 1st January, 1887, thus placing these shares on a par with the existing £3 paid shares of the corporation.

The West India and Panama Telegraph Company.—The report of this company for the half-year ending December 31st last states the amount to credit of revenue is £37,931, and the expenses have been £27,935, leaving a balance of £9,996, which, with the balance of £2,293 brought from last account, makes a total of £12,289, with which it is proposed to deal as follows: Payment of 6s. per share on account of arrears of dividend on the First preference shares, £10,369; balance to current half-year's account, £1,920.

The Direct Spanish Telegraph Company. — The general offices of this company are removed to Winchester House, 50, Old Broad Street, E.C., but the company's telegraph station (open day and night) remains at No. 1, Leadenhall Street (corner of Gracechurch Street), E.C.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th April are £3,156, as compared with £2,467 in the corresponding period of 1886.

The Great Northern Telegraph Company, Limited. The receipts for April, 1887 were £20,320; 1st January to 30th April, 1887, £81,520; in the corresponding months, 1886, £78,480; and of 1885, £89,300.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending May 6th were £3,722.

NEW PATENTS—1887.

6590. "Magneto-electric cut-out." W. H. SCOTT, E. A. PARIS. Dated May 5. (*Complete.*)

6604. "Combined battery and circuit closer." M. BAILY, J. WARNER. Dated May 5. (*Complete.*)

6620. "Telegraph wire insulators and holders." H. KOSTER. Dated May 5.

6623. "Making plates or elements for voltaic batteries." W. H. TASKER. Dated May 5.

6633. "Producing by electro-deposition ornamental designs and lettering on metal plates." W. H. OSBORN. Dated May 6.

6676. "Electrical appliances." A. J. BOULT. (Communicated by E. C. McEvoy.) Dated May 6. (*Complete.*)

6681. "Secondary batteries or electrical accumulators." R. E. B. CROMPTON, J. C. HOWELL. Dated May 6d.

6682. "Electrical distribution for lighting purposes, &c., and electrical measuring instruments for use therewith." J. SWINBURNE. Dated May 6.

6711. "Making carbon rods for electric arc lights." F. VON HARDTMUTH. Dated May 7.

6745. "Novel electrical apparatus for use in checking instructions on board ships." H. P. SHERLOCK. Dated May 7.

6748. "Telephone transmitters." H. J. MACLURE, R. D. BOWMAN. Dated May 7.

6754. "Dynamo-electric machines." R. E. B. CROMPTON, J. SWINBURNE. Dated May 9.

6805. "Electrical secondary generator." G. PHILPOT, M. C. STAPYLTON. Dated May 10.

6809. "Electric bell indicators." J. & E. ETHELBY. Dated May 10.

6828. "Regulating dynamo-electric machines." E. T. & D. HIGHAM. Dated May 10. (*Complete.*)

6829. "Electric batteries." P. JENSEN. (Communicated by O. Lugo.) Dated May 10. (*Complete.*)

6844. "Electric arc lamps." A. J. BOULT. (Communicated by C. M. Noble.) Dated May 10. (*Complete.*)

6851. "Electric glow lamps." A. F. ST. GEORGE, S. E. ROBINSON. Dated May 10.

6863. "Submarine telegraph." B. A. COLLINS. Dated May 10.

6869. "Primary and secondary batteries." H. H. LAKE. (Communicated by W. J. Ludlow.) Dated May 10. (*Complete.*)

6890. "Electrical distribution by alternating currents and transformers of electric energy." R. DICK, R. KENNEDY. Dated May 11.

6918. "Telegraphs." W. E. GEDGE. (Communicated by A. Claude.) Dated May 11.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1886.

1458. "Improvements in electro-telegraphic apparatus." J. J. EBEL. Dated February 1. 8d. Relates to the arrangement described in the No. of the REVIEW for April 30th, 1886.

3674. "Improvements in electro-plating apparatus." A. F. HARRIS. Dated March 16. 4d. Claim:—The improvements in electro depositing apparatus described, that is to say, the covering, insulating, or protection of such metallic surfaces in the depositing bath, which are not required to be plated, by means of coating such surfaces with India-rubber, enamel, varnish, gutta percha or other substance having the quality of insulation.

3718. "Improvements in or connected with electric railways." E. M. BENTLEY and W. H. KNIGHT. Dated March 16. 1s. 6d. Consists chiefly of means for branching the conduit tramway so that a car can readily pass from one track to another. To accomplish this the inventors provide with each branch track a branch slotted conduit, which starts from the main conduit at the branching point of the track, and continues parallel therewith, the branch slot leading directly into the main slot at the point of branching. The claims are 21 in number.

3756. "Improvements in or appertaining to the regulating apparatus for electric arc lamps." A. W. RICHARDSON. Dated March 17. 8d. Relates to the apparatus described in the No. of the REVIEW for April 1st, 1887.

4162. "Improvements in the construction and arrangement of electrical conductors, mainly applicable to telephonic purposes." W. CHRISTIANI. Dated March 24. 11d. Claims:—1. For the production of electrical conductors of all kinds free from induction, the use of solenoid-like coiled conducting wires in which, for the purpose of avoiding inductive action upon a contiguous conductor of the same construction, the angle of inclination of the coils to the longitudinal axis of the conductor is at least equal to 45°, substantially as described. 2. In the application of conducting wires such as are referred to in the preceding claim, to cables with solenoid-like double conductors, the combination of the two conducting wires of the double conductor with the double bifilar coiled switch electro-magnets in such manner that the one coiling of the switch magnet is included in the speaking conducting wire while the other is included in the induction conducting wire (compensation conductor) of the same double conductor, substantially as described. 3. In the application of cables with solenoid-like double conductors such as are referred to in the previous claim, in combination with single overhead end conductors, the use of the arrangements described with reference, in which one wire of the double conductor always serves for conveying the speaking currents while at the same time currents of reverse direction are produced by induction in the second wire, substantially as described. 4. In the application of cables with solenoid-like double conductors such as are referred to in the second claim, the use of double conductors for double speaking, the apparatus being connected in such manner that for the one speaking currents are employed that flow in the same direction in both wires, while for the second speaking currents are used that flow in opposite directions in the two wires, substantially as described with reference to the drawings. 5. In combination with the arrangement referred to in the fourth claim for double speaking, the use of telephones with double coilings and of microphones with double induction coils substantially as described.

4755. "Improvements in switches for making or breaking electric circuits." R. CORNTHWAITE and R. INGHAM. Dated April 6. 8d. Relates to the switch described in the No. of the REVIEW for February 18th, 1887.

4939. "Improvements in electric fire-alarms, applicable also for use as lightning arresters." G. A. MASON. Dated April 8. 8d. Claims:—1. In a normally closed electric circuit, the use of a spring or weight tending to break or rupture the circuit with a fusible material retaining the spring or its equivalent in the position in which the circuit is closed, substantially as described. 2. The combination for the purpose described of a spring or springs, kept in an extended or abnormal position, by means of a fusible material, and having connected to it or them a tin foil strip or equivalent piece which forms part of the circuit and is ruptured by the contraction or movement of the spring or springs when the fusible material is melted, substantially as described. 3. The combination of parts constituting the electric fire alarm or lightning arrester, as hereinbefore described and illustrated in the drawings.

5731. Improvements in galvanic batteries." A. DUN and F. HASSLACHER. Dated April 27. 6d. Claims:—1. The use in a two-cell galvanic element of carbon as negative electrode in combination with nitro-hydrochloric acid (aqua regia) in the one cell and as positive electrode, zinc or other metal soluble in soda lye, or soluble therein on closing the circuit in the other cell. 2. The use of ferric chloride in addition to the aqua regia in a two-cell element such as is referred to in the first claim, for the purpose of increasing the constant nature of the element and decreasing the diffusion. 3. In a two-cell element such as is referred to in the first claim, the use of chromic acid or of a chromate in place of the hydrochloric acid, for preventing smell, with or without the substitution of platinum or aluminium for the carbon.

14105. "An improved method of automatic electric signalling for railways, and apparatus therefor." W. WALKER. Dated November 2. 11d. Claims:—1. The improved method described of automatically operating railway signals placed at intervals apart along the line, each signal being, when at safety, held there by an electro-magnet, through the coils of which an electric circuit from a battery can be completed through an insulated wire which extends for some distance along the line, and through earth connections or their equivalent at each end, such earth connections being controlled by contact mechanism in such manner that when a train enters on the section of the line along which the wire extends the earth connection at that end is broken, and the signal brought to "danger" by gravity, and remains at "danger" until the train, on passing off from the section of the line, again causes the circuit to be completed, and the signal thereby to be set to "safety," or "line clear." 2. The means for automatically operating railway signals, substantially as described and illustrated in the drawings. 3. The railway signal head or target having a swinging arm carrying a coloured disc of glass, gelatine, and mica, or other suitable material, mounted in an enclosed space between the lens and a glass in rear of it, and acted upon by an electro-magnet, substantially as described.

14996. "Improvements in automatic electric current governors or regulators." H. J. HADDAN. (Communicated from abroad by C. F. Brush, of America.) Dated November 18. 11d. Relates to improvements in automatic electric current governors or regulators, and has for its object the automatic control and regulation of the strength of the current in an electric circuit in which the current strength is subject to variations due to variations in the speed of the armature of the dynamo-electric machines, or to varying resistances in the circuit, owing to an increase or decrease of work, or of the number of translating devices included therein, or to other or both of the causes specified. The invention consists in the combination with an electric circuit of a series of resistances and means actuated by the varying current strength in the circuit for automatically switching into an electric circuit the series of resistances (some or all of them) in multiple arc with each other. The invention further consists in combination of parts and features of construction, as described and pointed out in the claims. The claims are 27 in number.

16406. "Improvements in electric motors." N. H. EDGERTON. Dated December 14. 8d. Consists: 1st. Of a field of force composed of a cylinder or ring having attached to its inner side or bore two oppositely located pole pieces, one or both of which are provided with one or more sets of magnets or helices to provide

pole pieces, each of which is common to its own series of magnets or only one of said poles is common to a series of magnets, and the other is without magnets or helices. 2nd. Of a tubular motor casing having one or more sets or series or removable magnets and core pieces common to each said set of magnets. 3rd. Of a tubular casing having in its bore two oppositely located pole pieces, outside feet or supports, and detachable end caps having bearings for the armature shaft; and, 4th. Of an armature composed of an elongated sleeve or hub of any suitable prismatic or other configuration in cross-section, having radially-arranged magnets arranged lengthwise of the core or parallel to the armature shaft. The claims are 14 in number.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

(*Continued from page* 434.)

Experiments were now made with the lead, l, equal about to 0·3.

l = 0·3 about.

N	$s + \sigma$	σ	$L = \frac{60\,l}{N}$
0	4·06		
770	5·00	0·94	
1120	5·50	1·44	
1600	6·00	1·94	Mean value,
2000	6·50	2·44	0·0218 ohm-second.
2410	7·00	2·94	
2860	7·50	3·44	

These results when plotted give the straight line B B B (fig. 3, page 434). Instead, therefore, of calculating the value of L from several of the results, as before, we may more accurately determine it from the point at the end of this line corresponding with a speed of 3,000 revolutions per minute, and an apparent resistance of 7·7 ohms, that is, an apparent increase of 3·64 ohms. This gives for L the value 0·0218 second-ohm, also not differing much from the true value 0·0215 second-ohm, considering that the exact value of the lead was not known.

Lastly, experiments were made with a lead of about $\frac{1}{4}$, with the following results:—

$l = \frac{1}{4}$ about.

N	$s + \sigma$	σ	$L = \frac{60\,l\,\sigma}{N}$
0	4·1		
820	4·7	0·6	0·0219
1100	4·9	0·8	
1240	5·0	1·0	0·0217
1560	5·2	1·1	
1700	5·3	1·2	0·0212
1950	5·5	1·4	
2220	5·7	1·6	0·0216
2500	5·9	1·8	0·0216

Here, again, the points all lie very nearly in the straight line, C C C, and the values given in the last column, calculated from some of the points, are all nearly equal to one another and to the true coefficient of self-induction of the solenoid.

It is clear, therefore, that with speeds up to 3,000 revolutions per minute and higher, and with leads varying from $\frac{1}{12}$ to $\frac{1}{4}$, any single experiment correctly made gives the true value of the self-induction by the use of the simple formula

$$L = \frac{60\,l}{N}\,\sigma.$$

We see from the formula, and from the experiments which substantiate it, that the smaller the lead and the higher the speed of rotation of the commutating arrangement, the larger is the value of apparent increase of resistance, that is, the more sensitive is the test.

The iron core was now inserted in the solenoid, and a series of experiments made with leads equal to $\frac{1}{12}$, $\frac{1}{6}$, $\frac{13}{36}$, $\frac{17}{36}$, in the respective sets of experiments. The results are shown by the curves, D D D, E E E, F F F, G G G (fig. 4). It will be observed that, although the speed of rotation of the commutating arrangement did not exceed 680 revolutions per minute, the observations do not lie even approximately in a straight line, until the lead $\frac{13}{36}$ is employed, and even when the last lead $\frac{17}{36}$ is used there is still curvature in the line. This great difference between the curvature of the lines for a range of even slow speeds when the iron core is introduced, and the perfect straightness of the lines beyond the highest speed, 2,800 revolutions per minute, employed with the solenoid alone, arises from the coefficient of self-induction of the solenoid, with the iron core inserted, being about 25 times as great as the self-induction of the solenoid alone. Hence the smallest interval, T, between the closing of the battery circuit and the short circuiting of the galvanometer that can be employed is much larger when the iron core is inserted than when the solenoid alone is used. Consequently the lead must be large or the speed must be slow for the results to lie in a straight line. The curve, D D D, obtained with the lead of about $\frac{1}{12}$, is too far from straight for any portion of it to be used in calculating the

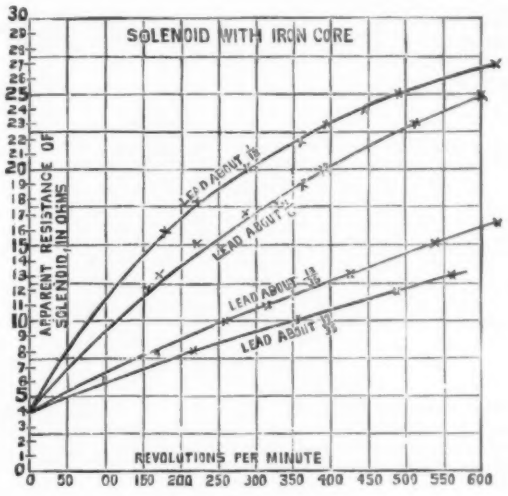

SOLENOID WITH IRON CORE
APPARENT RESISTANCE OF SOLENOID, IN OHMS
LEAD ABOUT 1/4
LEAD ABOUT 1/6
LEAD ABOUT 13/36
LEAD ABOUT 17/36
REVOLUTIONS PER MINUTE
0 50 00 150 200 250 300 350 400 450 500 550 600

FIG. 4.

coefficient of self-induction, with the simple formula; in other words, so small a lead was unsuitable to be used. The greater part of the next curve, E E E, is also too far from straight to be used, but the first observation, corresponding with a speed of 156 revolutions per minute and an apparently increasing resistance of 8 ohms, is on a portion of the curve sufficiently straight to give an answer not much smaller than the truth. The result so obtained is

$$L = \frac{60 \times 1}{156 \times 6} \times 8$$

$$= 0{\cdot}513 \text{ second ohm,}$$

which is not very much less than the true value of the coefficient of self-induction of the solenoid with the iron core, as determined by Lord Rayleigh's method, which, as before mentioned, gave 0·517 second-ohm.

With the lead of about $\frac{13}{36}$, the lowest speed at which an observation was taken was 170, corresponding with an apparent increase of resistance of 4 ohms. This gives

$$L = \frac{60 \times 13}{170 \times 36} \times 4$$

$$= 0{\cdot}510.$$

If we take the next speed, 260, corresponding with an increase of resistance of 6 ohms, we find L equal to 0·500.

The last curve, G G G, obtained with the largest of the leads, about $\frac{17}{36}$, is the one that, being straightest, will probably give the best results, but as even this is not quite straight we must expect to obtain slightly too low a value. The two first observations correspond with speeds of 220 and 355 revolutions per minute, producing an apparent increase of resistance of 4 and 6 ohms. The values of L obtained from these results are 0·515 and 0·482 second-ohm, from which we should conclude that the true answer was a little higher than 0·515 second-ohm, and this we know is correct, as the true answer is 0·517 second-ohm.

These series of experiments have been made simply for the purpose of experimentally investigating the law of the instrument, and it is of course not at all necessary to make all these observations for the purpose of measuring the coefficient of self-induction in any particular case, nor is it necessary that the commutator should be able to be run at a number of known speeds. If the instrument is to be used to measure coefficients of self-induction the values of which do not vary between very wide limits, then it is sufficient if the instrument be constructed so as to run at one fixed speed which is not too high for the currents to become steady with the largest coefficient of self-induction that the instrument is designed to measure. If the instrument be required to measure coefficients of self-induction all having rather a large value, and also coefficients of self-induction all having rather a small value, then it would be desirable to construct the instrument so that it would run at either one low known speed or at one high known speed. The greatest sensibility in the measurements of coefficients of self-induction of which the values range within wide limits is obtained by constructing the

instrument so that it can run at a number of known speeds. In practice, such a wide range instrument would be used as follows:—Before the instrument left the maker's hand the lead would be fixed and experimentally accurately determined once for all, and $60 \times l$ might be called the constant of the instrument, K. An experimenter, in determining the coefficient of self-induction of any coil, would—

First. Measure the resistance of the coil in the ordinary way.

Second. Rotate the instrument at some convenient speed, which must be noted, say N revolutions per minute, and by altering the resistance in one of the arms of the bridge until the galvanometer needle again comes to zero, observe the apparent increase of resistance of the coil, σ say.

Third. Rotate the instrument at some other convenient measured speed, say N′, and measure the apparent increase of resistance of the coil, say σ', above its original value.

Then, if

$$\frac{\sigma}{N} = \frac{\sigma'}{N'},$$

the apparent increase of resistance obtained with either speed may be used, and the required coefficient of self-induction

$$= K \frac{\sigma}{N};$$

if, on the other hand, $\frac{\sigma}{N}$ is larger than $\frac{\sigma'}{N'}$, then the speed N′ is too high, and possibly also is N, to give accurate results. Therefore, use a speed N″ lower than N, and measure the new increase of resistance σ''.

If now

$$\frac{\sigma}{N} = \frac{\sigma''}{N''},$$

the speed N was not too high to give accurate results, although N′ was; hence the apparent increase of resistance obtained with either the speed N or N″ may be used, and the required coefficient of self-induction,

$$= K \frac{\sigma}{N}.$$

If $\frac{\sigma}{N}$ be only a *little greater* than $\frac{\sigma'}{N'}$ and if N′ *much exceeds* N, then it will not be necessary to make a third experiment at the lower speed N″ unless very accurate results are desired, for the coefficient of self-induction can only be a very little greater than

$$K \frac{\sigma}{N},$$

which may, therefore, be practically taken as the correct value.

By the simple addition, therefore, of such a commutating arrangement as we have described to an ordinary Wheatstone bridge, it becomes possible whenever the resistance of a coil electro-magnet, &c., is being measured, to measure also the coefficient of self-induction in absolute measure by a zero method which is as sensitive for the measurement of self-induction as the ordinary Wheatstone bridge method is for the measurement of resistance.

From what precedes, it follows that

$$L = K \frac{\sigma - \sigma''}{N - N''},$$

so that if s_1, s_2 be the apparent resistances of the coil at two speeds, N_1, N_2 revolutions per minute, the speeds not being two large

$$L = K \frac{s_1 - s_2}{N_1 - N_2},$$

so that *the coefficient of self-induction can be determined from two experiments made with the revolving double commutator without knowing the true resistance of the coil at all.*

If there be doubt as to whether the speeds N_1 and N_2 are too large a third check speed, N_3, may be used, or, instead, as explained in Appendix II., a rough test of the resistance of the coil for steady currents may be made, but time need not be spent in obtaining an accurate balance as quite a rough balance can be used as follows:—Let 0 on the scale be the true zero for no current passing through the galvanometer, and let the spot of light be at 156 divisions when an approximation is made for balance for steady currents, the resistance of the coil appearing to be s ohms. Let h be the ratio of the time the battery is on to the total time when the commutator is rotating at any speed, then the zero to be used on making the *second* and *third* tests just described is $h \times 156$, and σ is the increase above σ the approximate values of the resistance for steady currents.

Commercial Forms of the Instrument.

The long-range instrument, previously described, requires an electro-motor to drive it, and a speed-indicator to register its speed, hence it would be too cumbersome for every-day work. Further, as it is very difficult to maintain the absolute constancy of the speed of a small motor driving a friction brake, like our commutating arrangement, at a high speed for any considerable time, in consequence of very slight variations in the friction of a high-speed brake producing marked variations in the speed, it requires two experimenters to use the form of our instrument already described; one to vary the resistance until the galvanometer needle comes to zero, and the other to note the speed of the motor at the moment that the first experimenter gives a signal that the galvanometer needle is at zero.

Hence, in the autumn of last year, we were led to consider what form should be given to the commercial instrument to be used for the measurement of self-induction in this way. The main condition of the problem was that the instrument should be able to be used by one experimenter *alone*, since one experimenter alone can measure a resistance with a Wheatstone bridge, and therefore we felt that if another experimenter had to be summoned when a coefficient of self-induction had to be measured, the instrument would lose much of its practical value. Our first idea was to employ clockwork that would drive the commutating arrangement at various fixed speeds, determined by the adjustment of a certain powerful governing arrangement, and to this end commutators of very small diameter were constructed, so as to waste only a small amount of power in friction and interfere but little with the action of the governor. The problem at first sight appeared an easy one, but the experiments of one of our assistants, Mr. Bourne, whom we have to thank for the many ingenious devices that he has suggested, and for the skill that he has brought to bear in the construction of the various experimental forms that the apparatus has passed through in its developments, showed that in consequence of the high speed of the commutator, and of its acting as a friction brake, good results could only be obtained with clockwork of such unwieldy dimensions as to make it impossible for the instrument to be made portable; further, it was contrary to our engineering instincts to employ an apparatus which wasted so large a portion of the power required to drive it in the governing arrangements.

When making the experiments with the original commutating apparatus, two methods suggested themselves of obtaining a balance—the one, to try and to keep the speed of the electro-motor nearly constant, and to vary the resistance of one of the arms of the bridge, by trial, until the galvanometer needle came to zero; the other, to commence by increasing one of the arms of the bridge by a definite amount, and to vary the speed of the electro-motor, by trial, until the galvanometer needle came to zero; and it soon appeared that the second method was the one that would have to be adopted in a practical instrument, since, while it is very difficult to maintain a constant speed, there is no difficulty in obtaining a gradually diminishing or increasing speed. For example, the apparatus may be provided with a fly-wheel having a large moment of inertia, and may be driven by hand more or less fast until the galvanometer needle comes to zero. The next step in order to avoid the necessity of a second experimenter was to devise a *recording speed-indicator*, and the best form that we have arrived at is based on the principle that we employed in constructing an apparatus some years ago for experiments on centrifugal force, described at a meeting of the Physical Society at the time, and in regular use in the mechanical laboratory of the Finsbury Technical College ever since, for experiments on centrifugal force. Attached to the commutator of our self-induction apparatus is a box, B (fig. 5), fitted with weighted elastic sides made of corrugated steel, which fly out more and more, under the action of centrifugal force, as the box is rotated faster and faster.

A stout glass tube, G, of comparatively small bore, open at both ends, is cemented into a collar in the axis of the box, and rotates with the box. The box is completely filled with mercury, and the tube partially, hence when the volume of the box expands as its sides fly out, and the length of the column of mercury in the tube diminishes, so that the length of the column at any moment is a measure of the speed of rotation of the box. In the neck of the collar, C, in which the tube is cemented, there is a steel tap attached to an axial spindle passing through a tube inside the box, and projected out of this tube at the other end of the box. If this spindle be turned relatively to the box, the tap is opened or closed. At the commencement of an experiment the tap is opened, and the handle, H, is turned with the right hand, faster and faster, until, on depressing the key, K, with the left hand from time to time, the galvanometer needle is seen to be approaching zero, or the spot of light the zero position on the scale. The key may now be kept depressed, and on turning the handle a little faster a speed is at length reached producing exact balance—if the handle be turned faster, the needle or spot of light deflects to one side of the zero, if more slowly to the other—at this moment the trigger, T, is lightly touched with the left hand and a spring is liberated. This has the effect of producing a resistance to the rotation of the tap spindle, which previously was rotating freely with the rotating box, and the tap is thus turned off, cutting off the connection between the mercury in the glass tube and that in the box. Consequently the mercury in the tube remains, even after the instrument is stopped, of exactly the same length that it had when the trigger was touched. *The position of the end of thread of mercury in the tube is now read off on the scale attached, and the apparent increase of resistance of the coil, electro-magnet, or whatever it may be, divided by the number on the scale gives the required coefficient of self-induction in second-ohms without any further calculation.*

The instrument is, therefore, *direct reading.*

The first form of recording speed indicator was intended to be used in a vertical position, as may be seen from the shape of the framework. But we soon found that great advantages were obtained by putting it *horizontal.* If the tube be vertical, the pressure on the elastic sides of the box due to the column of mercury in the tube diminishes as the column sinks on the speed of rotation being increased. And as this variation of pressure is avoided by placing the tube horizontal, the instrument is very

much more sensitive in a horizontal than in a vertical position. The experiments made at the Finsbury Technical College with the vertical centrifugal force apparatus show that the fall of mercury is very accurately proportional to the square of the speed of rotation, whereas direct proportionality is what we desire in a speed indicator, and this we find we can obtain, except close to the zero, by placing the tube horizontal. Further, since with the tube horizontal there is no pressure on the sides of the box due to the mercury in the tube, the sensibility of the instrument is not varied at all by altering the amount of mercury in the tube, provided that the scale be placed so that the zero on it is opposite the end of the thread of mercury when the box is at rest. Should any spilling of the mercury accidentally occur when the instrument is carried about, the sensibility will not be in any way altered.

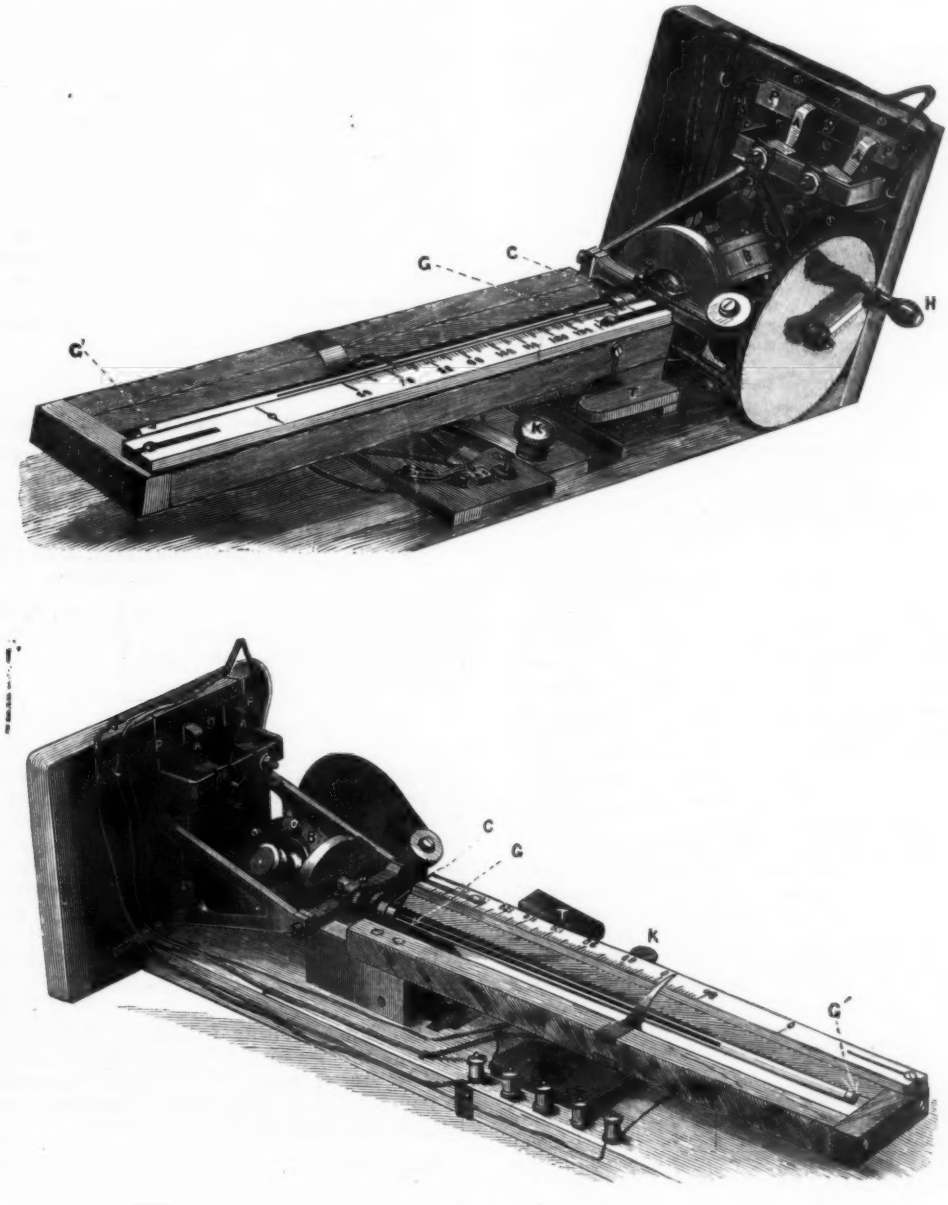


FIG. 5.

Consequently by placing the tube horizontal we obtain far greater sensibility, direct proportionality, and constancy in the indications.

Variations in the temperature from day to day also cause alterations in the volume of the mercury, and so alter the length of the thread of mercury in the tube, but this introduces no error in the experimental result, nor difficulty in using the method if the tube be horizontal, since before the commencement of the experiment the scale is slighly moved until the zero on it comes opposite the position occupied by the end of the thread of mercury on the day in question when the box is at rest.

At first, rotating commutators similar to those shown in fig. 1, page 432, were employed with the apparatus shown in fig. 5, next the brushes were made of a variety of different forms, so as to press *radially* on the rotating commutators to prevent the wear altering the lead and thus changing the sensibility of the instrument, but this form of commutator has at length been entirely superseded by the two oscillating arms or brushes, A, A, worked by a cam. Each arm is composed of several pieces of hard copper, contact being made through the ends, as in many of the switches now used for electric light work. The end of each brush alternately rubs on a flat piece of phosphor bronze, P, P, when it makes contact, and on a *flat* piece of glass or agate, *g*, when it does not. This form of commutator we found superior for our purpose to the double cylindrical one, since, with the two oscillating arms, the lead can be more easily varied for adjustment, and this slight adjustment of the lead, we may here mention, forms the fine adjustment in the construction of this direct-reading instrument. Further, the slow wearing of this form of brush does not alter the lead, consequently the value of the graduations of the scale remains constant.

The lead aimed at in the construction of these instruments is $\frac{1}{4}$, as that gives an equal time to each operation, but in any actual instrument it may be made a little more or less than $\frac{1}{4}$, being slightly altered, as just explained, in the final adjusting of the instrument by the maker.

It might appear, at first sight, that the two ends of an oscillating lever, or the two prongs of a vibrating tuning fork, would perform the required makes and breaks in the right order, but a reference to the cycle of operations given in the table, page 433, and a little consideration, will show that the two prongs of a tuning fork cannot perform the required cycle of operations in the correct order.

Following the precedent of naming an instrument after the name of the unit employed, for example, "ammeter," "voltmeter," "ohmmeter," "wattmeter," it seems desirable to call this instrument after the name of the commercial unit of self and mutual induction. The absolute electromagnetic unit of self and mutual induction is one centimetre, a name used by all scientific nations. But the commercial unit of self and mutual induction is $99{,}777 \times 10^4$ centimetres, or second-ohm, which is a little less than 10^9 centimetres, or one earth's quadrant. Now in spite of the difference between these two numbers, which, although small, it is a pity to lose sight of, the English word "quadrant" is not used in French or German, therefore it would not be well to suggest this word as the international name for the unit. Yet it is most important that some name should be universally adopted, since the use of simple familiar names has much to do with making people familiar with the laws of the effect measured by the unit. The unit of electrostatic capacity, the farad, has been called after the greatest experimental worker in electricity; it would therefore seem appropriate that the unit of electro-magnetic capacity should be called after Maxwell, the greatest mathematical worker in electricity. We do not, however, like to propose this, as we feel there might be difficulty in obtaining the general acceptance of the name of an Englishman, however great, unless it were sanctioned by an international electrical congress, or unless the man's name was intimately associated in men's minds with self and mutual induction. Now Maxwell's large contribution to the subject of electro-magnetic induction is surrounded by his equally large contributions to all other branches of electricity and magnetism—a giant surrounded by giants is not prominent. Coming to the last two years, we are glad that the leader and all those who have followed him in taking part in the widening of our ideas on self-induction are still with us. Hence we are driven to suggesting a temporary name for the unit, and as the first three letters in "second" are common to the name in English, French, German, Italian, &c., and ohm is also common, we venture to suggest "*secohm*" as a provisional name, and our instrument we will therefore call a "*Secohmmeter.*"

(*To be continued.*)

CORRESPONDENCE.

Secondary Generators or Transformers.

I have noticed Messrs. Zipernowski, Dèri and Blathy's remarks on my articles, in reply, I beg to say that I had very clear ideas of the closed magnetic circuit, as far back as 1873, when I was a student in London. The closed magnetic circuit of Faraday was exhibited in 1875 at the Loan Collection of Scientific Apparatus. I do not claim anything regarding closed magnetic circuits, and I could refer to other closed magnetic circuit transformers earlier by a few years than those used by these gentlemen.

The ring shown in my 1883 papers was shown coupled as a polar transformer for the purpose of the discussion in which it figured. I was combatting the ideas of Messrs. Gaulard and Gibbs, who then advocated the polar transformer and the series system, and I therefore, to be strictly accurate, drew my diagrams to correspond with the subject of the discussion. At the conclusion of the paper, I stated the connections were so made for the purpose of the measurements, pointing out that they might be coupled otherwise in series or parallel.

I think no one will deny that after my decided statement that if transformers were to be connected in parallel instead of series, they would then become beautifully self regulating; the parallel system was known to me in 1883.

My whole contention in my 1883 papers was the impracticability of the series system, and I did not then care about making public my full knowledge of the parallel system known.

Rankin Kennedy.

May 9th, 1887.

Electro-Motors.

In your issue of April 8th appears an article on a small motor, to the criticism of which I beg leave to make a few objections.

Notwithstanding that it is stated in the first two lines of said publication that the motor is intended for use on arc light or constant current circuits, the writer in his subsequent utterances seems to have constant potential circuits in his mind.

That shunt-wound motors will regulate themselves on such circuits I happen to know. Still, I am thankful to the writer for reminding me of the fact.

When it is asked what meaning the term "full speed" possesses, where the article, as copied from the New York *Electrical World*, speaks of the efficiency of the motor, I must confess that a typographical error has caused obscurity, read "full load."

As the diameter of the armature is but $4\frac{1}{4}$ inches, the speed of 2,000 revolutions per minute can hardly be called excessive. I endorse the statement that a motor, capable of developing 3 H.P., can be made weighing but 125 lbs.

The last question, what becomes of the E.M.F. at the terminals, which was 223·8 volts when the motors gave 3 H.P., can be answered by the statement that the E.M.F. for obvious reasons does not exist any longer after the field coils are cut out.

One more word. If you would have the kindness to inform me who runs shunt wound motors efficiently and with self-regulation on arc light circuits in series with such lights, or other current-consuming devices, and also where such motors could be seen, I would deem it a great favour.

W. Hochhausen.

April 22nd, 1887.

Ring Dynamos with Interior Magnets.

As we think it may be of some interest to your readers, we beg to enclose you herewith a communication with reference to a new form of dynamo which has been brought out by our Berlin house.

For **Siemens Bros. & Co., Limited.,**
AL. SIEMENS.

[The communication to which Messrs. Siemens Bros. & Co. refer will be found at the beginning of our present issue.—EDS. ELEC. REV.]

Cardew's Voltmeter.

Those of your readers who are users of the above instrument may be interested to hear that the very annoying oscillations of the index, due to air currents in the tubes, may be entirely stopped by using the voltmeter in a horizontal position. As the weight of the wire causes the deflection to be somewhat reduced, recalibration is necessary before using a voltmeter in the new position.

This simple remedy for a grave defect is due to Mr. G. S. Ram.

Sydney Evershed.

P.S.—Since writing the above I learn that Prof. Ayrton discovered the same remedy some twelve months since; I think that many others will join me in regretting that this useful knowledge has been so long buried in the professorial bosom.

S.E.

May 11th, 1887.

Theatre Lighting.

We notice in your issue of the 6th inst. an unfavourable criticism on the electric light at the Prince of Wales's Theatre by "Troubadour." His statement about the lamps giving only 4 C.P. is an absolute fabrication; no such thing having ever taken place.

We need only refer you to Mr. Edgar Bruce's report, expressing his entire satisfaction at the working of the installation, and you will see that it is unnecessary for us to reply to an anonymous and perhaps interested critic.

E. L. Berry & Co.

May 12th, 1887.